Among Green Trees

by Julia Ellen Rogers

AMONG GREEN TREES

AMERICAN ELMS IN A NEW ENGLAND VILLAGE

DEERFIELD, MASSACHUSETTS

AMONG GREEN TREES

A GUIDE TO PLEASANT
AND PROFITABLE ACQUAINTANCE WITH
FAMILIAR TREES

BY

JULIA ELLEN ROGERS

ILLUSTRATED

CHICAGO
A. W. MUMFORD, PUBLISHER
1902

The Lakeside Press
R. R. DONNELLEY & SONS COMPANY
CHICAGO

TO MY FATHER AND MOTHER

DANIEL FARRAND ROGERS AND RUTH LLEWELLYN ROGERS

PIONEERS OF THE TREELESS PRAIRIE

WHO PLANTED SEED AND SAPLING

WHO TOILED AND HOPED AND WAITED TO MAKE FOR THEIR CHILDREN

A HOME AMONG GREEN TREES

"Aye keep plantin' a tree, Jock; it'll be growin' while you're sleepin'."

CONTENTS

PART I

OUTDOOR STUDIES WITH TREES

THE NATURE-STUDY SIDE

PART II

THE LIFE OF TREES

THE PHYSIOLOGICAL SIDE

PART III

THE CULTIVATION OF TREES

THE PRACTICAL SIDE

PART IV

THE KINDS OF TREES

THE SYSTEMATIC SIDE

LIST OF FULL-PAGE ILLUSTRATIONS

ALPHABETICAL LIST OF ILLUSTRATIONS

HALF-TONES AND LINE ENGRAVINGS

And what a glorious object is a TREE! How magnificent a forest of them on the boundless plain or on the mighty hill-side! And the solitary tree — there is scarcely its match for beauty among unintelligent objects on the face of the earth. They are surpassed only by him who walks among them in living and thinking grace and beauty. "In form," though not in "moving," like him, "how express and admirable!" The thick-topped maple, with its wholesome-looking foliage, in whose close and dark recesses the hang-bird sings her "wood-note wild" in the hot summer noon. The lofty, clear-limbed, open-boughed button-wood, with its dainty leaf, its scarred trunk, and excoriated branches. And the elm, the patriarch of the family of shade — the majestic, the umbrageous, the antlered elm! We remember one at this moment — in sight from our old home on the banks of the Pemigewassett. It stood just across that cold stream, by the roadside, on the margin of the wide intervale. It stood upon the ground as lightly as though "it rose in dance," its full top bending over toward the ground on every side with the dignity of the forest tree, and all the grace of the weeping willow. You could gaze upon it for hours. It was the beautiful handy-work and architecture of God, on which the eye of man never tires, but always looks with refreshing and delight.

* * * * *

The planting of a sapling is a trifle in expense. There it grows, and costs nothing but time. Every tree is a feather in the earth's cap — a plume in her bonnet — a tress upon her forehead. It is a comfort, an ornament, a refreshing to the people. It is a virtue to set out trees. It is loving our neighbor as we love ourselves. Set out trees — not to make your home outshine your neighbor's — but for him to look at and walk under, and to beautify God's earth, which he clothed with trees.

NATHANIEL PEABODY ROGERS.

("Herald of Freedom," Concord, N. H., August 6, 1841.)

PREFACE

We now have a half-dozen recent popular books devoted to the trees of the northeastern United States and Canada. These books are well written, well illustrated, and sold at a reasonable price. The aim of each is to describe all the trees, or approximately all, and to show the general reader how he may learn to know them apart. All this is as it should be, and I doubt if any other country is so well provided. But the book that describes *all the trees* has this obvious limitation: it can have little or no room left for other interesting and practical matter about trees. In short, the "identification book" which deals only with the kinds and names of trees is necessarily one-sided, and there is a great need and a clear call to-day for an "all-round tree book."

Moreover, *all the trees* are too many for most readers. The greater the number to consider, the harder it is to distinguish and to remember them. Few of us care to *know about* all the oaks; it is the ten or a dozen common oaks that we want to *know*—to recognize wherever we see them growing. This book aims in Part IV to describe the common and important trees that grow in the states north of Virginia and Arkansas, and east of the Rocky Mountains. Among the native species are included many forms introduced from other countries, and commonly planted in the United States. About 125 different kinds of trees are described.

The limits set to the identification part of this book give room for the consideration of much besides that is of interest and importance to any one who loves trees and longs for a closer and more intelligent acquaintance with them. In Part II the author has nothing new nor startling to reveal on the subject of the life that a tree lives from day to day. The facts stated are set down in books already. But these books are written for the special, not for the general reader. They are learned books, which abound in technical terms. They satisfy the scientific mind which has this particular botanical bent.

Because "general readers" do not throng the public libraries asking for works on Physiological Botany, Dendrology, and Horticulture, some would conclude that they have no interest in the underlying principles upon which the life of a tree depends. And yet you have but to speak of one of these principles in simple, every-day language to discover that people are keenly interested. Recognizing this truth, the author has attempted to state clearly, accurately, and in small compass the essentials of tree physiology, to interpret the language of the specialist, and to present scientific truths in a form that will attract and satisfy the general reader.

Thousands of dollars are expended each year upon the services of quack "tree doctors," "tree scrapers," "expert pruners," and their ilk, who prey upon the good intentions of a credulous public. The idea that a plug of lard and sulphur pushed into an auger-hole in the heart of a tree will cure all its diseases seems reasonable to people who have given no special thought to the subject of how trees are made, and how they feed, grow, breathe, sleep, and why they die. The voluble "doctor" confuses them by his comprehensive grasp of the subject, and easily beguiles the owner into having his neglected trees treated—at $1.00 each! Time and again have such preposterous notions been exploded in the newspapers. Yet the tree doctor flourishes, and his deeds follow him but slowly and afar off.

Part III, therefore, deals with horticultural phases of the subject. It is devoted to practical every-day problems. How to plant a tree, how to prune and shape it, how to keep it free from insect enemies and fungous diseases, how to renew the youth of old and neglected trees—these are some of the problems discussed. A chapter gives the reader an idea of what forestry is; another suggests means of applying its principles to the farmer's wood lot and similar small areas. The application of the simple but fundamental principles of Landscape Gardening to the planting of home grounds is one of the live problems to which attention is called, especially as it bears upon the improving of small yards in cities and villages. Another subject is the making of nursery trees, including the various means by which ornamental trees and shrubs, the variegated and cut-leaved and weeping forms, are multiplied for the market. The interest in planting the home grounds and the enlightened public

interest in the beautifying of parks, school grounds, and cemeteries is one of the most hopeful signs of the age.

Last in this survey of the scope of the book, but first in the volume and in the heart of the writer, is the Nature-study side of the subject, Part I, — Outdoor Studies with Trees. In its broadest sense, Nature-study is a keen, appreciative interest in the common things about us. It means accurate seeing and clear thinking. Nature-study is the most vital idea to-day in education. It is the getting of God's truth at first hand. It is *studying things* instead of *studying about things*. Do not call it Elementary Science. The true spirit of Nature-study is opposed to cold, formal study of lifeless things. It is the informal study, for short periods, of things that interest. It opens a new world of delight. Under it, the commonplace becomes transfigured. It shows us how we may get the very best out of life no matter where we are, how to realize the possibilities of happiness that exist even in the most unpleasant environment.

This book, then, has at least four points of view: — The *nature-study* side, which embraces outdoor studies with trees, quite independent of books; the *physiological* side, which is fundamental to all intelligent tree culture; the *practical* side, with directions for the care and cultivation of trees; lastly, the *systematic* side, which distinguishes the kinds of trees, and explains their family ties.

Such is the writer's conception of an "all-round tree book" for the general reader. The field covered is a wide one. The author disclaims any pretensions of having given it an ideal treatment. If any credit is due it is merely for the recognition of a distinct field, — the appreciation of a great and well defined need of the people. The present volume is, let us hope, but a beginning. The life of the trees is a fascinating study. It grows upon one. To any one, young or old, who loves trees and longs to know them better, this book aspires to be a friendly helper and guide.

JULIA ELLEN ROGERS.

Ithaca, New York, October 1, 1902.

ILLUSTRATIONS AND ACKNOWLEDGMENTS

The photogravures of entire trees and the half-tones of trunks and leaves are from negatives made for the exclusive use of the publisher, and are identical with those used in the portfolio known as Series I, II, and III of Typical Forest Trees. The line engravings are from drawings made under the direct supervision of the author. The most of them were drawn by Mrs. Marie Robertson Duggar and Mr. W. C. Baker. A few were done by Mrs. Agnes Rogers Kerr and Mr. A. M. Garretson. The frontispiece was made from the original negative by Miss Mary Allen, of Deerfield, Mass.

The botanical nomenclature in this book conforms with that of Sargent's Silva of North America, except in the case of the sugar maple, in which the specific name, *barbatum*, used by Sargent, is replaced by *saccharum*, the name agreed upon by the leading botanists of the country since the publication of the Silva.

The chapter on "The Sleep of the Trees" was published first in "Primary Education," and is reprinted here by permission. The author is under obligation to Mr. George W. Cavanaugh for his critical reading of Part II; to Professor L. H. Bailey, at whose suggestion the preparation of the book was undertaken; and to Mr. William K. Higley for kind assistance in many ways.

PART I

OUTDOOR STUDIES WITH TREES

THE NATURE-STUDY SIDE

THE LIFE HISTORY OF A MAPLE

To an intelligent and sympathetic questioner an aged tree speaks freely of its later life, but of its youth it tells little. We must begin at the beginning if we would read the story of a tree's life. Where is the beginning? Is it the sprouting of a seed? No, for what is a seed but a little plant which lies within the inclosing seed coats waiting for release? The next question is, When was the seed formed?

Gracefully swinging key fruits of the red maple

Let us go with our last question into the woods in March, when the red maple begins to glow against the grim darkness of the leafless trees. It is the red buds set opposite upon the twigs that warm the gray old tree. They have felt the stir of the sap. All the tree can ever express of life and beauty and energy must come through these buds. A few of them lead the rest. The outer scales are shed, the inner ones lengthen as if they would be leaves, and then a rosy veil encompasses the tree—the red maple is in bloom!

The tree has two kinds of blossoms. Both have cups set round with crimson petals. One bears within on slender filaments a number of yellow anthers, which give the opening flowers a yellow cast. Out of these anthers shakes the pollen like golden dust. The other flowers are ruddy of hue. They bear no anthers at all, but instead, thrust out of each cup a red stigma like a forked tongue. The inner faces of this stigma are sticky. At the base of each half is a closed chamber in which lies a tiny soft body called an ovule. It may become a seed. But that depends upon chance.

The air is full of pollen grains—of poplar, birch, and alder; of elm, willow, and maple. The grains are so small and so light they drift on the wind. Some are borne on the hairy bodies of insects that go from flower to flower. Pollen of all of them (or of none) may happen to lodge on the sticky surface of a red maple stigma. This is *pollination*. But all strange pollen lies there inert. A grain of maple pollen is the

Red buds set opposite

only kind that makes any impression. It absorbs the sweet juices present in the stigma. A tube grows downward like a little root among the loose tissues. Still feeding and growing the tube reaches the ovule and enters it by a little doorway. An egg-cell is within, and a sperm-cell is in the end of the pollen tube. The two unite, and thus the *fertilization* of the ovule is accomplished. This is the beginning of the life of the tree. The fertilized ovule ripens into a seed.

Look at the maple tree just after blossoming time. The staminate flowers strew the ground. Their work was done when they cast their pollen. But the pistillate flowers do not fall, although stigmas and petals have withered. In the place of stigmas pert little horns are rising. They are to be the wings of the maple seeds. The stems lengthen, and on each one of them two crimson winged samaras, or key fruits, swing gracefully in the breeze. Late in May the tree, now clothed in its unfolding leaves, loosens its seeds and gives them to the winds. Each little key must shift for itself. Where shall it alight?

Yellow anthers borne on slender filaments

I know a maple tree which stands in the edge of the woods where the ground is stony and broken. An oozy bank above it waters the thirsty roots of many plants. In front is the broad, hard highway in which no seed can grow. Behind is the deep leaf mould on the forest floor. All kinds of soil are spread under the tree. Which seeds will be the fortunate ones? They veer and sail and pitch to earth, driving their pointed bodies before the lighter wings. In most of these winged seeds there is a sleeping plantlet. Warmth and moisture are required to wake it into life. If these are not supplied, the plantlet waits. If it waits too long, it loses its own moisture and dies. In a favorable situation the seed will germinate without delay.

Stigmas thrust out like forked tongues

There are two long seed leaves folded palms together and then coiled in the seed pocket of the key. There is a little stem that joins the two. This is all we see. The waking seed absorbs the water. The seed coat cracks along its edges. The two leaves uncoil and lift into the light. The stem elongates and turns toward the soil. There is a small bud between the seed leaves. It lifts and opens out a pair of true leaves. The lengthening root takes hold of the soil by means of fine rootlets. The picture shows the little tree, relying for its growth upon

The little tree dependent upon its seed leaves

the food stored in the seed leaves; and yet the leaves and the roots promise that before long they will be able to gather food "from honest mould and vagabond air," that the tree will come to be independent. In the next figure this promised time has come. A faint scar shows where the seed leaves were attached. Here they shriveled and were finally shed. The stem and root grew longer. Two new leaves unfolded at the top of the stem. But vicissitudes await each little tree. For every well grown specimen under the parent tree there are twenty cripples. The tender tip of our maple seedling is sacrificed to the appetite of some hungry insect, or it breaks off in a lashing wind.

The last picture tells the interesting sequel to the accident that broke off the central bud. Much time remained of that first growing season. The energies of the plant, no longer able to express themselves in terminal growth, forced into shoots the buds that were growing in the axils of the two large leaves. By the end of the season they had extended to *b*, *b*, one obviously stronger than the other taking the lead. No better proof of vigor is needed, nor of good soil and plenty of sun, than this forcing out of buds intended for the following year.

Spring comes again, and the second year extends the two forks. Two by two the leaves are unfolded, just as in the first year. The root goes deeper, the stem goes higher. Both add an outside layer of wood and an inner layer of bark to the parts that grew the year before, thus adding to their strength as well as to their substance. If both of the limbs persist, the tree will always be forked close to the ground. The chances are that the smaller one will soon be overshadowed by the larger one,—that it will dwindle and die. Then the stem will straighten and grow on into a single trunk, giving no sign that it ever was a cripple.

The beginning of a life of independence

It will be worth while to set a stake beside this two-year-old seedling maple, or otherwise mark its place, so that year by year we may note its progress. It is one of many, and truly it lives the strenuous life. The rivalry of these little trees is no playful exercise,—it is a matter of life or death. Choose you a pair of lusty two-year-olds and watch them grow. Try to find out why one outdoes the other.

The interesting sequel

How different and yet how much alike are the life histories of these maple trees. Each succeeding year repeats and multiplies the labors of the last. Each summer earns the rest of the long winter. The contest for light, for room, for foothold, and for food becomes more intense as the tree grows. And when at last the wood-chopper, or the lightning stroke, or the less merciful agencies, insects and diseases, remove the parent tree, its place will be taken by that one of its offspring which has overcome in the struggle with its own kind and with other plants which cover the ground it stands on. The young red maple, casting its first seeds upon the ground, enters formally upon its career as a full grown tree. It is now an integral part of the forest, having attained its majority.

Come, then, let us to the woods together to see what is happening among the trees. Let us inquire of the saplings that form the miniature forest below how it fares with them. Let us find out, if we can, what their past has been, and what are their prospects for the future. Trees speak a language, if only we have the patience to learn it. It is a sign language, and through it they tell us all manner of interesting things about how they make their living—about their hopes and their disappointments.

Are you afraid? Do not the denizens of the woods treat you civilly? When have they scolded you, or bitten or stung or poisoned you? These are foolish fancies. Go into the woods without fear. Show yourself friendly, and the forest and all the creatures that dwell together there will delight you with their gentle friendliness.

RED MAPLE

Acer rubrum

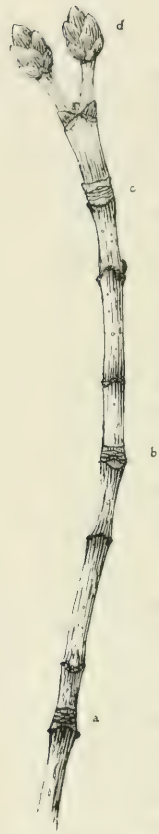
HOW TO TELL THE AGE OF A TREE

It is not always necessary to cut down a tree in order to find out how old it is. Each twig and branch bears a record of years, written in the scars of bud scales and leaves. In old trees the reading of these records is often a task, but with young ones it becomes a delightful amusement. It has the fascination of detective work. After your first successes, you find yourself questioning every tree you meet. Your friends get interested with you, as soon as they learn the key that unlocks the tree's secret.

With experience comes facility, and the undertaking of more difficult problems. The old apple tree by the roadside challenges you to make out the story of its eventful life. You can learn to read the record of last year's crop. You can tell exactly how many fruits a particular branch has ever borne, and even whether they reached maturity or were picked green. The promise of next year's crop is revealed to you, though you cannot foretell whether the flowers will be frosted. The veteran recites to you its past successes and failures, declares the year it came into full bearing, the time of the big wind or the ice storm that broke so many large limbs, and you can even give a shrewd guess as to whether the tree has been a profitable investment or not. It is as if the owner kept an account with each individual tree and opened up to you his book of record for this one.

But come, let us try our skill. Young trees have all the *naïveté* of children. They shout their ages at us almost before we have time to ask for them. Let us go down where young maples are starting a "sugar-bush," or where young beeches cover the floor of the woods. Here are a graded series of reading lessons for us. We will leave the cripples for a later time, and consider only those which have had a fair chance, and have grown as nature intended them to. It is best to begin with kinds that are characterized by rapid growth—that have big buds and lusty stems. They speak a language that is clear and plain. Perhaps the first thing you notice is a ring of scars. What does this mean? Each branch finishes its year by forming buds. Every spring it begins to grow by casting off the scales that protected these buds over winter. The scales leave a little group of scars to mark the place of their attach-

ment. Now, on the main trunk of any little tree, let us count back from the tip to the ground. The length between each two of these groups of scale scars represents the growth of a year. Now we have the clue.



A four-year-old twig of Norway Maple

The oldest side branches are a year younger than the main stem. Every branch, great or small, is normally a year younger than the stem that bears it. Each tells its age by its groups of bud scars. The youngest wood is set with buds in winter, and in summer all the leaves are borne directly upon shoots that grew from these winter buds.

Very commonly there is a difference in the bark of various years' growth. The newest shoots are greener, smoother and more herbaceous in texture than the older ones. All buds on older wood are dormant. They should have grown into leafy shoots the season after they were formed. When we have determined the age of a certain little tree, we may strengthen our faith by a further test. You think that a certain part of the stem is four years old. Cut it off and see if you can count around the pith the rings of wood inside the bark. If there are four, your judgment is vindicated.

Let us challenge every little tree that we meet. Those that have had a hard life will give us some problems. They are so small, and yet so old. But remember the fixed principle. Bud scales mean *winter*. Each group of their scars on a stem marks the end of another year's growth.

When we have learned to read these records in little trees, we may look up and read the same story among the branches of the older trees. The twig that gets the most light and air is lustiest in growth, and its story is the easiest to read. The picture shows us a twig of Norway maple. Let us count its groups of bud scars. Three full years of growth they record on a base which is four years old.

It is now the spring of 1902. In April, 1899, a bud threw off its scales at *a* and grew to *b*, bearing three pairs of leaves and a terminal bud. In April, 1900, this bud opened, and grew from *b* to *c*, bearing three pairs of leaves and a terminal bud. In April, 1901, the bud at *c* started, bore a pair of leaves, then died by some accident, and the two buds in the angles of the leaves carried the growth forward to *d*, and formed each a pair of leaves and a bud, which is full of promise for 1902.

This maple twig's story is a tale of woe. I found it on a lower branch where it rarely got any sunlight. It has borne twenty leaves

whose scars are plainly seen. Each leaf *should* have had a bud in its axil, and these buds *should* have grown when a year old into side shoots. All these possibilities have failed except in the special emergency case at the top. A single bud below *c* remains, but it has been dormant for a year, and is probably dead. All the others have died and fallen off. But the lusty end buds have better light and more air. The growth would probably have been better from this time forth if I had left the twig on the tree.

The final test

The final test of age is made by a slanting cut through the wood of the different years. Each year of age reduces the size of the spongy pith and adds a thin belt of compact wood. Why is it so thin? The leaves are the nurses of their own buds, and the feeders of the twig that bears them. Growing in shadow, they are small; they get but little food from the soil and the air; they can make but little starch to send to needy, dependent parts. Hence, the short growth made by this twig each year, the weakness of its buds, its failure to increase in diameter. All these are but outward signs of the poverty that for years has been the portion of this unhappy little twig.

But all over the treetop we may find to contrast with the ill-favored twig lusty ones that tell a story of free and independent life, where sunshine and sap and good fresh air abound. Want and plenty, misery and happiness exist side by side in the world. We read all about them in the books and in the treetops!

THE FLIGHT OF SEEDS

When we want a symbol of independence we are wont to point to a great tree—a sturdy oak, perhaps. Yet how helpless trees are, after all! Like Prometheus chained to the rock, they cannot move, while creatures smaller than eagles but fully as ravenous, come to prey upon them. Their sacred mission in life is the propagation of their kind. Yet in performing it how dependent are they upon blind chance!

Fruit of the Black Ash

There are great epochs in the lives of trees, and great days in each year's calendar. Critical indeed is the time when the flowers open and the pollen is given to the wind and to the insects. Upon these unconscious and irresponsible agents largely depends the setting of seed. The maturing of the seed may soon be accomplished, or it may be a long, slow process, which fills a whole summer, or even two. With its completion another critical epoch is at hand. The tree yields its precious seeds to the heedless wind or drops them upon the ground. The fate of each tree-child trembles in the balance while the parent tree is powerless to take any further part in the great work of seed distribution.

As a matter of fact this point of view is altogether human and somewhat sentimental. There is not so much chance, after all. The bee is wonderfully efficient in the pollination of flowers. She attends strictly to business, and for her the day is long. Between dawn and dusk she visits countless flowers. The wind may be a reckless fellow, but he often works while we sleep or play. Then, too, many species of trees will survive without cross-fertilization or wide dissemination. Trees have ways of propagating their kind that do not involve the seed at all. But, what subject is so interesting as the flight of seeds? No wonder it appeals to the imagination and holds the attention of us all!

The seed of ash trees is like a dart. A flat pointed case contains the embryo, and out behind it extends a thin, light two-edged wing. The seeds hang in clusters securely fastened on wiry stems. They break loose a few at a time in high winds, and flutter and hesitate as they turn over, to point their heavy ends downward. They may go like an arrow straight into the snow or the leaf mould under the tree; or, if the wind is blowing a gale, the seed may be caught by the current and borne far away before a lull lets the little dart point downward again and the seed find its way to the earth.

Tiny pods of Willow

The willow is one of the earliest trees to ripen its seeds. The long terminal catkin hangs for days with little green pods along its sides. Then suddenly the pods burst, the two halves curl back out of the way, and the tiniest specks of seeds float out. Each one is hid in a misty tuft of silk which is so light it seems as if it would never reach the earth, and in truth much of it never does. Whether it does or not makes little difference to the willows. So feeble is the embryo in the seed that it dies in a day if it is not lodged in a place favorable for its germination. Willows do not depend upon their seeds. Blossoming and seed-growing is with them largely a matter of form—of loyalty to the traditions of their family. Multiplication is much more surely and vigorously accomplished by casting off twigs and branches which strike root in moist soil near the tree, or float down stream, lodging and growing on sand-bars or river banks. Thus do willows spread, while the wind is busy scattering their ineffectual seeds.

Seed ball of the Buttonwood or Sycamore tree

In April the elm trees, leafless yet, show the green tips of opening leaf buds, but much more noticeable are the green seeds that hang like dainty pendants in clusters from the sides of twigs. Because they are many, the ground is thickly sprinkled with seeds which the tree can not ripen. By the time the leaves are full-sized the seeds are ripe and scattered. Each is a thin flat disk with the embryo in the center of a surrounding wing. The American elm has a fringed seed, with two incurving hooks that

Fruit of Hop Hornbeam or Ironwood

meet at the apex. These seeds float far on the wind, for they are as light as feathers.

All winter the button balls dangle by their stringy stems on the twigs of the buttonwood trees. They bang against each other and against the neighboring limbs when the wind whips them to and fro. The seeds are dry and ripe. They stand as thick on a central pit as grains of corn on the cob. At length a bump harder than usual loosens the attachment of a few of these seeds. They bulge out and the next bump sets them free. In a short time not a seed is left on that particular button. Each little seed is shaped like a slender cone, attached by its pointed end. Near the tip is a whorl of yellow hairs which spreads and forms a parachute that checks the seed's headlong flight to the ground and bears it some distance.

Catalpa seeds

The catalpa tree stands all winter hung with its pencil-like pods. The two valves loosen gradually as the winds buffet them, and the seeds slip out, one by one. And a strange looking seed it is! From the central embryo, two long wings, thin as tissue paper, taper into ragged fringes. The whole thing looks like a wraith of a seed, from which nothing might be expected.

The tilting rafts of Ailanthus seeds

The hop hornbeam or ironwood sends its seeds afloat in balloons. Take off one of these little paper bags, open it, and you will find set at its base a shiny, pointed seed. There is likely to be a long journey before this seed, for until it is safely underground, or its bag punctured, the wind gives it no rest.

The hornbeam has a quaint little scallop shell on which its seed is launched. The seed itself is firmly fastened in the prow

of the boat and the wind carries it, careering in many directions before it finds its last resting place.

The slim blade in which the ailanthus embryo sets sail is like a long, tilting raft. In winter the clusters of seeds seem fairly to burden the trees. One by one the little rafts let go their hold and sail away.

Did you ever lie under a silver maple tree in June and watch the falling seeds? They are twins as they grow on the tree, but they separate when ripe and each takes flight alone. The heavy tip goes first, and the wing whirls madly round and round as the descent is made. The maples are many, but they all bear winged, lop-sided seeds which whirl and flutter away before the wind, or fall to the ground under the tree when there is no breeze to carry them farther.

Twin keys of the Soft Maple

All the conifers open the scales of their ripened cones and give to the winds a delicate winged seed which looks like a miniature maple key. Some cones stand erect and, curling back their loosening scales, fairly unseat the seeds and shove them forth. The cones of other trees hang down and the seeds fall out as the scales relax and spread and dry.

Pods of the Honey Locust

On the basswood trees the seed clusters cling long after the leaves have fallen. They are downy little balls, each with one or two good seeds in it, and all are joined on a single stem which grows out of the middle of a leaf-like blade. When this stem lets go its hold upon the tree the broad blade acts as a parachute. The wind takes a keen interest in it. Gravitation and buoyancy have a strife for mastery, and the basswood seeds generally fall to earth some distance from the tree that bore them.

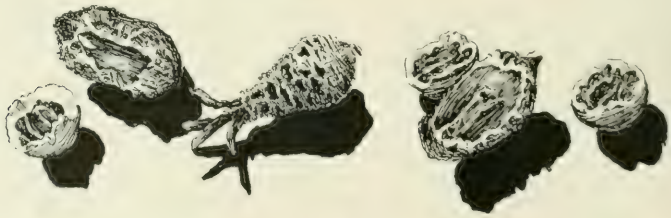
Basswood seeds on their leaf-like blades

The honey locust has long purplish pods, which rattle their hard little seeds as they fall in winter. The wind catches the curving blades and tilts them out of

equilibrium. Always a resisting face is presented, always the breeze resents it, and the pod knows no rest until it is anchored by some weight which defeats the lifting power of the wind. So honey locust seeds germinate far from the parent tree, while the heavy straight pod of the Kentucky coffee tree lies undisturbed where it fell. The little Judas tree and the common locust hold out their thin, leathery pods, and as the wind bears them away the valves part and the seeds are scattered.

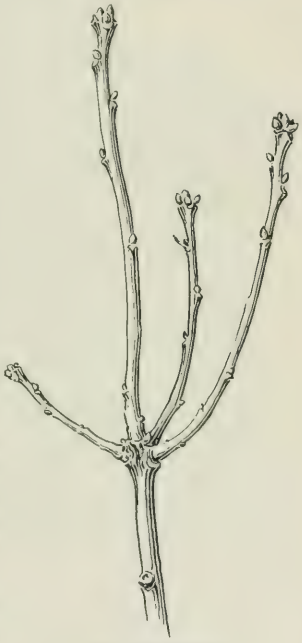
Birds carry the seeds of many trees and drop them in places remote from the tree that bore them. Many a wilding apple or pear by the roadside grew from seed so distributed. Squirrels gather acorns and other nuts where they fall, and hide them by tens and dozens in little pockets under the snow or leaf mould along their winter runways. They store them for food, but many nuts are left untouched, and spring up into trees. On hillsides acorns may roll some distance. Gusts of wind may snatch them from the twigs and fling them in any direction. As a rule, however, the wind has little to do with the distribution of the heavy seeds of nut-bearing trees.

When we look off over a forest set with broad-leaved trees and conifers, where gleam the white limbs of sycamores, the tattered trunks of birches, against a background of hemlocks and junipers; when we walk through such a wood, breaking off a twig of sweet birch here, and of sassafras there, and picking up chestnuts and hickory nuts under foot, we wonder how the trees all happened thus to mingle together. By what chance does a rock maple grow here and a willow yonder, and a Judas tree between the two? We must watch for the seeds to ripen on these trees, and we must come again to watch the launching of the seeds. Then some of our questions will be answered. Happily, most trees are loath to give up their fruits. Any day in winter as you walk through the woods you may watch these misers grudgingly dole out their treasures to the insistent wind.



THE BATTLE AMONG THE TWIGS

The white oak I see from my window has a dozen main branches that spring out of the trunk at various levels. Each branch subdivides again and again. The outside of the dome of the tree is a maze of small twigs whose buds are practically countless. In winter the tree is sound asleep. The wind whips the branches together and breaks off some buds and twigs. But among the tree's own fighting forces there is a truce until spring. Then comes the battle of the buds that rages without ceasing till winter comes again.



The habit of the White Oak

Let us examine this oak branch with its winter buds upon it, and see what signs there are of the coming conflict. Four twigs rise from a common point. Each bears scattered side buds and a cluster of stronger ones at the tip. The side buds average less than an inch apart. Last summer a leaf was borne under each of them. They were not too close. White oak leaves are deeply lobed,—their stems very flexible. Light and air can therefore reach them even when they are set closely. But that was last year. What is this year's problem? Each bud set on these twigs is a branch in miniature. Each one is ambitious to produce a leafy shoot. There was room enough for the leaves. Is there going to be room for branches? Suppose each bud should carry out its plans. About forty shoots, each bearing ten leaves, would be the result. Four hundred leaves on a two-year-old branch scarcely fifteen inches long! Follow it on for another year. Fancy these four hundred buds grown into leafy shoots each bearing ten leaves. There would aggregate four thousand leaves, all on a branch three years old and less than two feet long!

The buds never realize their ambitious hopes. The mathematics of

it reduces the problem to an absurdity. So does a look at the diagram. But a small percentage of the buds that form can develop. Which ones shall they be? The weak ones may stay out of the contest; the strong ones contend in a silent, continuous strife for room, for food, and for sunshine. The first buds to open are the ones farthest out and the first ones to show green leaves are the ones that can first appropriate sap that rises in the stem. The green leaves take in carbon from the air, add it to the crude sap, elaborate these raw materials, and send the nutritious products to their own growing shoot. As the leaves attain their full size the outer and upper ones cut off the supply of sunshine from those below. More and more crowded do they become. More and more sharp is the competition among them.

If the buds all grew—a logical conclusion

The biblical text finds no truer application than here in this struggle among the leaves—"Unto every one that hath shall be given." Lacking sunshine, the under leaves could not elaborate the sap even if they had it; so they fade and fall and the upper ones are prospered. Vigor and favorable situation are the beginnings of success in this long struggle. Weakness keeps many buds from starting at all. Those that start feebly are starved and shaded to death by their more prosperous brothers.

The growth our twig will make in the next few years may be predicted with fair accuracy by looking down the branch and reading something of its past. The death of side shoots and the persistence of but one or two of the terminal ones is the rule. We may expect the twig in the picture to have its growth extended through its two longest shoots, the weaker two failing after this year. Side shoots will probably start from a few of the strongest buds. But they will fail in a year or two, as they must clash with others, and be cast into shade.

The tree top rises ever higher from the ground, year by year. Our twig will soon find itself smothered by those that extend beyond it, if it does not lengthen its terminal shoots and keep a tuft of leaves out in the sunlight. For this, the best leaves cluster at the ends of the twigs; the best buds form there; the energy of growth is concentrated there.

It is a most fascinating thing to notice the careers of those buds that are sacrificed to serve the best interests of the whole tree. For a year

WHITE OAK

Quercus alba

or two they remain dormant,—not dead, but sleeping. If all goes well above them they die in a year or two. But if an accident cuts off the life of the growing shoot above them, the dormant buds wake and grow. The tree kept them alive as a sort of life insurance plan. They are to be called upon in case of emergency. They grow as soon as they have a chance. Sunlight, sap and air are all they need; they begin to grow as soon as these necessaries are supplied.

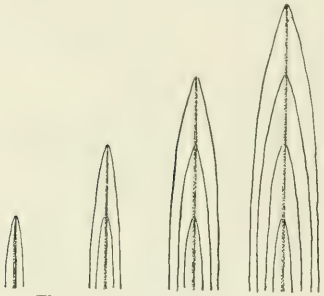
Every tree top tells the story of Nature's "divine wastefulness"—provision for thousands where only hundreds can find room. Leaf, flower, fruit, bud, and twig contest unceasingly for place and food and sun. Consult an apple tree in spring, and then in fall. Count the blossoms on a certain branch. Then count the fruit. Go to it in early summer when the tree casts off as if in despair the fruit it cannot ripen. The trunk of every tree is the burying ground of thousands of twigs and branches which succumbed in the struggle. The branches we see are a small number compared with those which tried to grow and gave it up.

Nowhere better than in this battle in the tree tops can we read the full text of the great natural law of the "Survival of the Fittest," also known as the doctrine of "Natural Selection"—that great body of truth the enunciation of which has illumined the human understanding and made immortal the name of Charles Darwin.

STOVEWOOD STUDIES

KNOTS AND KNOT-HOLES

If we ignore for a moment the fact that a tree has branches we may think of its annual increase in height and diameter as the slipping on over its head each summer of a hollow cone made of closely packed straight wood fibers. Each year a larger and taller cone would be required to fit the one under it. A cross section of this tree would show the annual rings of growth. If trees were only made without branches there would be rejoicing in the congregation of the wood-workers. The carpenter could plane a board with his eyes shut, with never a worry about the edge of his tool, and the labor of the wood-chopper could be set to music. As an ornament to the landscape, however, such a tree would scarcely be considered a success. We turn with satisfaction from the faultless wooden cones to the real tree that spreads its branches all abroad. With all its complexities, the tree still holds this rule of growth. Wood fibers are laid on in yearly cones between the bark and the wood. The diagrams tell a true story.



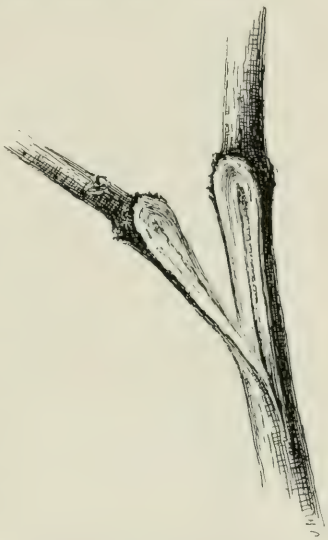
The way a tree grows, year by year.

It is the branching habit in trees that makes the knots and knot-holes, and is responsible for most of the irregularities of the grain of wood. Each leaf on the little seedling tree bears a bud in its axil. Every bud is a possible branch. The multiplying of leaves, year by year, multiplies the number of buds and branches. Every branch began life as a bud, and its origin can normally be traced back into the pith of the stem that bears it. As long as it lives the branch grows in length and thickness exactly as the trunk does. It adds its wood cones year by year, and shows them as annual rings when cut across.

There is no better place to study how trees grow, and to find out the meaning of knots than at the wood pile. Let us go out and consult the sticks of stovewood and see how many questions they will suggest to

us, and how many they will answer. We shall need a branch with its small twigs for reference when we come to speak of knots, and a pocket-knife is indispensable. The axe lies in the block. We shall need to do some chopping perhaps before we are done.

With our previous notions that the trunk and branches of trees are cylindrical, it is rather disturbing to find that among the unsplit wood round sticks are very rare. They are *roundish*, generally, but often flattened. Frequently one end is circular and the other oval in outline. Annual rings are rarely perfect rings. They circle around a point which is not exactly in the middle. There are twisted sticks and humpy ones — sticks sound from bark to center—others that are mere hollow shells. There are sticks that are smooth and straight-grained. There are others that are distorted by knots.



"A twig torn off tells a very plain story"

What is a knot, anyway, and what makes a knot-hole? A knot is the base of a branch buried in an older stem. Normally, it is just one year younger than its parent stem, for branches rise from buds, and buds are formed in the axils of leaves. The following year the bud unfolds into a leafy shoot, while the stem is taking on its second layer of wood. With each succeeding year the branch and stem both add wood layers, increasing their diameters. Gradually the base of the limb is swallowed by the thickening trunk.

When a tree is converted into lumber, knots appear in the boards. They are of all sizes and conditions. There are sound knots of healthy limbs, and black knots caused by disease that entered through an injured limb, and worked down into the heart of the tree. There are "loose knots" that fall out, because the cambium was the part the disease attacked. The stub may be eaten out entirely so that there is no knot at all, but only the knot-hole left. The closing of the outer wound by the healing bark may or may not check the disease that is at work within.

Let us see how these knots affect the grain of the trunk. Find a stick that has a split surface from which the stub of a branch projects toward you. The fibers are straight above and below it. They seem to curve out to right and to left and go around the limb. Above, the fibers come

straight down, and spread abruptly just above the knot; but below, they flare gradually from a point some distance below the knot. A middle strip of fibers widens gradually, then flares suddenly so as quite to encompass the limb. The outer fibers of this strip meet above, and run out on the upper side of the limb parallel with each other, the strip, so narrow below, widens and forms a sleeve which fits the limb perfectly. To the right and left of this strip are the fibers of the main stem that go round the knot and meet above it. There is a rather weak joining of the bias edges of this sleeve with these fibers on the main trunk. This is what makes limbs so liable to split away from the main stem. Often they split by their own weight. Orchard trees break down by the burden of fruit. Snow on evergreens causes similar breaks—so does the lashing of winds; but those under fibers which unite the trunk and limb do not part. Often a large limb tears down to the ground and out upon a trunk root before the hold finally breaks.

Twigs set upon branches tell a very plain story about the disposition of fibers. Tear a small twig out by the roots. It has a cone-shaped base. Was it not very small when it began, and has it not added to its diameter each year inside the trunk as well as outside? Take off the bark by peeling it up from below. The "sleeve" comes off whole. Less flexible are the wood fibers, but you will soon see that they form under sleeves, one for each year. The bark fibers follow the lead of the wood fibers.

If we split a two-year-old branch through its pith and out into the pith of a twig, we shall find the fibers below running from main stem to branch. Take a number of fibers up *below* and they generally tear out into the limb. But *above* the limb there is no such fibrous connection. The fibers go to the angle of limb and trunk and no farther. At this point the fibers part to go around the base of the twig. The split through the center has cut them off.

A knot in a board is a section through the base of some limb. If the knot is set slanting, the limb met the trunk at an acute angle. If it makes a right angle with the board, then the limb grew out horizontally from the trunk. I am speaking of ordinary lumber.

Let us note again how closely the buds are set upon a twig, and then notice how far apart are the large limbs upon the tree. Those limbs we see are but a few of the many that aspired to grow. If we should saw the trunk into thin sections we could read the record of all these attempts and failures. The close-set shoots on the sapling stem live a year or two, and then finding that there is not room for them, or that the leaves above cast them too much into the shade, many die and drop off. In another year a layer of straight-grained wood covers the place where they were.

But there always remains deep in the heartwood of a great tree a memory of every little branch that started to grow but died in its infancy. Each one is a knot that causes some ripple of the fibers—a little disturbance of the straight grain.

The tree that grows in an open field with plenty of sun and air is branched from top to bottom. Such a tree is full of knots of all sizes, and its wood makes a poor grade of lumber. But let a tree grow in a crowded forest, and all the little lower branches are whipped off by neighbor trees, or starved for light. Such a tree makes fine timber, free from large knots.

Two-year-old Basswood branch with yearling twig

In maple trunks there is a peculiar tendency to preserve any little unevenness of surface, and to magnify the peculiarity by molding subsequent annual layers over the humpy places. Most trees would fill in the hollows, and go on straight. This peculiarity gives us the beautiful *curly* grain occasionally seen in maple. When buds on maple saplings are crowded many are likely to remain dormant, but they live on, hoping there may yet be some chance for them. Other buds may be formed—adventitious ones—among them. All may keep on growing inside the trunk though their noses are rarely poked out beyond the bark. Each of these buds is the center of a pimple in the wood. When the saw cuts off a slab, the lumberman's shrewd glance detects the valuable *bird's-eye* maple. There is an eye for each bud, encircled by beautiful wavy rings.

The wood of elm and cypress often gets cross-grained, especially near the base of the trunk. The fibers will veer to the right for a few years—then swing to the left. The hop hornbeam sometimes winds its fibers spirally about the trunk. Some species of pine exhibit this peculiarity. A distinct waviness is sometimes seen in wood usually straight-grained. Such a condition may be due to the crowding and interlacing of the ends of fibers which lengthen after being formed in the cambium layer. Often a beech tree has its outer layers of wood and bark thrown into wrinkles. Extreme irregularities of grain generally add much to the market value of lumber. The beautiful patterns, and the fine blending of colors many show when polished, give woods a place in the decorative arts that can be taken by no other material.

II. A PINE SHAVING AND AN OAK SPLINTER

For kindling wood that will split commend me the "soft" pine. Set the hatchet into the top of a stick with no matter how light a stroke, and the spread of the blade sends a cleft on before it. Down the length of the blade the hatchet follows, but never overtakes the cleft unless there is a knot. Then one of two things will happen: either the grain will lead the hatchet by a gentle curve around the knot and on, or it will lead it right into the knot, and the chopper will have to chop his way out. But that is another story. Let us sit down on the chopping block, and look at our straight-grained kindling stick.

Plainly, pine wood is fibrous stuff, like the lean of meat. Cut it any way you like — across the grain, with the grain, or at any slant. The evidence on this point is always clear. Cut off a shaving that dwindles out into nothing. The wood becomes almost transparent, and frays out into shreds. The finest thread may be torn into still finer ones. The fibers of pine must be very small.

My shaving is an inch wide, and shows eighteen bands, each pale shaded to deeper yellow. This means that it took a certain tree eighteen years to produce that inch of wood. It must have been grown by an old tree, and in its old age. A thrifty young tree would have done as much in half the time. Twelve years to the inch is the average, taking all kinds of trees as they come in the woods. So says an eminent authority.

In each yearly band of our pine shaving the dark yellow part is the *summer wood*. It gradually succeeds the pale *spring wood*. The cells formed in the early part of the growing season are larger and more loosely packed than those formed later. Holding our shaving up so that the light will strike upon its roughest surface, we may readily see bands of fibers that cross the grain at right angles, and look like thin blades set vertically and cutting through the annual layers. These are the *pith rays*. They extend from the center of the tree to its circumference. In pine they are numerous though small, and almost cover any radial section. Under the microscope the wood of pine is seen to be made up of long, straight, hollow cylinders, packed together and closed at both ends. These are fibers called *tracheids*. Each has along its sides little curtained doorways or pores, called *bordered pits*. Through these openings the sap is able to course in and out of the fibers. The pith rays are bundles of fibers, just like the rest, except that they are shorter and smaller.

Among the fibers of pine wood are pockets which are full of resin.

WHITE PINE

Pinus Strobus

These are not tubes, but simply intercellular spaces without walls which enlarge as the resin accumulates. Resin is not the sap of pine trees, as many suppose. It is a substance made by the breaking down of cells. Its origin and use to the tree are not well understood. When a pine tree is wounded resin flows out and covers up the wound, thus preventing the intrusion of disease germs. The gum of cherry trees serves a similar purpose. Whether protection is the purpose for which these substances exist is quite another question, and is at present unanswered.

Our pine kindling stick is a type of the so-called *non-porous woods*, which simply means that the fibers are so small that their hollows are invisible to the eye except under a magnifier of high power. All cone-bearing trees have wood of this kind.

No such regularity of shape and arrangement of fibers is to be seen among the woods of the broad-leaved trees. They are all classed as *porous woods*. The oak is a type of this class. We may take a stick of oak from the woodpile, or better, examine the surface of any piece of oak furniture. The varnish brings out more clearly the details of structure of the wood.

Oak is coarse-grained wood, full of "holes," but its fibers are tough as sinews and hard as bone. They are spindle-shaped and extremely various in size. They are crowded together, big and little, breaking joints by the overlapping of ends. Here is one secret of the toughness of oak wood. Many fibers end near together in pine, and they do not overlap, hence the brittleness of the wood. Oak fibers have many open doors in their sides and ends that permit the free circulation of the sap. These doors are as various in shape and size as are the fibers they belong to. They are not curtained as the bordered pits of tracheids are.

The annual rings of oak wood are shaded from light to dark. But unlike the pine, the dark edge is the *spring wood* coarsely porous, and quite narrow in good lumber compared with the band of yellow close-knit *summer wood*. Oak lumber has broad and very prominent pith rays crossing the grain. "In specimens of good white oak it has been found that they form about 16 to 25 per cent of the wood." (F. Roth, in Bulletin No. 10, U. S. Department of Agriculture.) They form the gleaming bands which are the "mirrors" seen in "quarter-sawed" oak. In other than radial sections of the wood they appear as brown, more or less long and narrow pencils crowded in between the bundles of wood fibers. Because these large pith rays interlace the other wood fibers, and because the regular longitudinal fibers are tough, and overlap their ends, the splitting of oak is a difficult matter compared with the splitting of pine.

THORNS AND PRICKLES

In the midst of an old pasture stands a stunted apple tree. By all the signs, it is a close relative of the thrifty trees that grow in the neighboring orchard. They are large because they grow in fertile soil and are given careful tillage. But this ugly dwarf sends its roots into a hard crust whose nourishment is largely stolen by the mat of grass roots.

Wicked-looking thorns of Honey Locust

The twigs have had little encouragement to grow. Every ambitious shoot has paid dearly for its temerity. It has become a sweet morsel under the tongue of some hungry cow. Starved and browsed to the point of utter discouragement the tree stands—a most unlovely shape, with stubby twigs hardened and sharpened into ugly spurs that look like thorns. Over in the orchard the twigs are long and lusty, with ample leaves and plump buds; and there are no thorns at all. The fat and lean kine of Pharaoh's dream were not more like and more unlike than the fat and lean apple trees we are considering.

Nevertheless the pasture tree does grow, if very slowly, and there comes a turning-point in its life. Its roots find better and deeper feeding ground. Among the young shoots there is one that is out of harm's way. It is in the very middle of the top. The cows come by and are cheered by the sight of it. They lean toward it, but the longest neck is not quite long enough. The thorny twigs make a stubborn defense. One last inch of distance cannot be compassed by any patient, yearning tongue. The shoot mounts up and out of danger. Its twigs grow soft and succulent. One can almost fancy that the parent tree is neglecting the lower branches in order to give this youngest one the best of everything.

Plainly, apple twigs grow soft and leafy when well fed. Poverty and abuse make them crabbed and thorny. Stunted twigs are the products of "hard times." The carrying of weapons is a habit to which the trees are driven by adversity, and which they abandon as soon as "good times" return.

On the other hand, there are certain trees which habitually bear

thorns. One of them is the honey locust. Above the opening leaf a sharpened point comes out of the twig. At the end of the season the leaf falls, but above it is left standing the wicked-looking three-pronged thorn, sharp as a needle and hard and smooth as if enameled. It is not uncommon to see a honey locust tree with trunk and limbs fairly bristling with these thorns, the largest approaching a foot in length.

A thorn, still soft, set with tiny leaves

What are these thorns? Are they branches, assigned to special duty, and properly uniformed for their work? It is useful and interesting at this point to bring in for comparison a branch of one of the hawthorns. Near the end of the branch is a half-grown leaf in whose axil arises a slender thorn. It is green and soft, and set with a half-dozen tiny leaves. Farther down are bigger thorns, set in the axils of full-grown leaves. These thorns have hardened. Below, on older wood, are thorns of larger size. Some of them have leafy shoots on their sides. Here we have a series of thorns, the youngest of which show the leaf-bearing habit of the twig, the oldest ones, the twig-bearing habit of the branch. The honey locust thorn shows the branching habit. Tear off any of these thorns, and you find them attached to the stem just as the twigs are.

On evidences like these the botanist bases his belief that thorns are branches, hardened, pointed and destitute of leaves, gradually modified by the plant to serve its special needs. The beginning of such modification has been seen in the pasture apple tree. The process has progressed much farther in hawthorn and honey locust, where the branch has assumed a kind of disguise—the livery of its special office.

A bigger thorn, hard as enamel

The common locust bears at the base of its leaf two sharp points, and each leaflet repeats this peculiarity by having two tiny guardsmen of the same kind at its base. But these points, though they persist and some of them grow large and strong, do not rise from the wood of the branch as do thorns. They come off with the bark. Hence they are *prickles* such as grow on rose bushes and raspberry canes. They are mere outgrowths of the bark.

Certain spines are evidently modified leaf ribs. The holly that we see at Christmas has the edge of its leaf contracted between spiny points. The barberry shows all the gradations between leaf and spine on the same twig.

In arid countries the vegetation tends to be leafless and spiny. Not cacti alone but other plants have their surfaces reduced and hardened or otherwise protected against loss of moisture in the hot, dry climate. In more humid regions the same species of plants have their spines dilated into leaves.

Each modification of bark or leaf or branch into prickle or spine or thorn is an expression of the varying needs of plants, and is the final result of Nature's attempt to adapt plants to their surroundings. We cannot say that thorns exist for defense against injury by animals, for we have no absolute proof of it. Yet it seems to us an obvious inference. We must avoid jumping at conclusions. Nothing is easier than for us to deceive ourselves by unconsciously projecting our experience into nature. Our point of view is not the same as the plant's. It is easy to say that cacti have thorns to protect them from being browsed by cattle. Scientific research, however, shows that the thorns of cacti are probably mere incidents to the contraction of the whole plant body, the main enemy being drought rather than browsing animals.

The truth in these matters of adaptation and specialization of parts can be gotten at only by a thorough study of each plant's actions under varying circumstances. The student must come to his work with his mind free from preconceived notions and theories on the subject. If, in many cases, he finds his researches unfruitful, there is always this question to ponder upon: "Is it reasonable to expect Nature to reveal to me in a few months or years the stages by which, through centuries, perhaps, she has been making perfect the adaptation of this plant to its present environment?"

LOCUST

Robinia Pseudacacia

WINTER BUDS

I. THE MEANING OF THEM

It is a common thing for people to look into the tree tops in February and exclaim, "See how the buds are swelling!" As a matter of fact, the buds are no bigger then than they were in October and December. But the air certainly has a feeling of spring in it, and we naturally look for the signs that give encouragement to our hope that the winter is waning. When were these buds formed? This is a very reasonable question.

Ailanthus twig

Away back in apple-blossoming time when the leaves are but half-grown and still covered with downy hairs the little buds may be discovered deep in the angles between leaf and twig. Examine the trees of door yards and of forest and you find the apple tree but exemplifies the general rule. Buds show their beginnings with the opening of the leaves, they grow all summer, and reach maturity by the time the leaves are shed. All winter they are dormant, but with the rise of sap in March and April they swell and burst and grow.

What is a bud?

It is a miniature branch. It may bear leaves or flowers or both. Suppose it is a *leaf bud*. This does not mean that it will bear but a *single leaf*. It means that the winter bud will cast off its scales and lengthen into a twig which will unfold young leaves. This process will continue throughout the growing season, the tip and the stem between the leaves gradually elongating. These leaf buds produce most of the foliage of trees. The long leafy shoots of quick growing trees sometimes attain wonderful length in a season. I have seen ailanthus shoots that grew ten feet in a summer. *Flower buds* cast their scales, and blossoms are revealed, single or clustered. The full development of these may soon be accomplished, or it may require a whole season. The elm blossoms, borne in side buds, ripen into seeds which are shed late in May. This ends the career of the bud. A flower bud of peach produces a single flower, whose development into a ripe peach occupies many weeks, perhaps all summer. *Mixed buds* cast their scales in

spring and unfold shoots which bear leaves and flowers. Apple and pear blossoms are thus borne in leafy clusters.

Buds are not alike in appearance, even on the same branch. They are large or small, strong or weak, according to their contents and the chances they had when they were forming. The leaf is the nurse of the bud in its axil. If that leaf had plenty of air and sunshine, and its share of sap, then will its bud be well formed. In most cases the terminal bud is largest, because it had the best advantages when growing. Leaf buds are likely to be slender in form, flower buds more plump and more hairy; mixed buds, as they contain leaves and flowers, are usually larger than buds containing flowers or leaves alone.

Tip of Sumac twig

The winter buds are the promises one year gives to the next. In them are packed away the leaves and the flowers, all perfectly formed but very small. In them is the only possibility of lengthening shoots and thickening stems. In them lie all the tree's hopes for the future.

II. A FASCINATING STUDY

Most people consider themselves lucky to know the commonest trees during the growing season, recognizing them by their leaves, flowers, or fruit. But when winter comes they can hardly be sure of a maple, or even an elm. It is not easy to grasp distinctions of shape, habit of branching, or the characters of bark, and express these things in words. If people only knew that each species of tree has a characteristic winter signature, which is imprinted hundreds of times on each individual tree, they could transform many a dull winter day into hours of delight.

This tree signature is no fanciful thing, and it does not require a microscope. "He who runs may read," if he will but break off a twig as he runs. *The winter bud and the leaf scar below it,* — these form the tree's autograph, a sign that is never misleading, — a sign that is as easy to recognize as are leaves or flowers or fruits.

Do you want a young tulip tree to transplant from the woods in early March? You saw a fine one in the summer time. Go out to dig it, and your eyes, and your memory, will tell you which one it is. The tulip tree has a characteristic bud. Once seen, it will never be confused with buds of other trees.

The study of winter buds is a fascinating business. You may begin

at any time after midsummer, for then the buds are well grown and the leaves are loosening their hold. Learn one at a time. Tear off a leaf or two from a familiar tree and notice the bud and the leaf scar. You will not forget. In winter you will find those well-remembered characters in the woods, and thereby know the tree that bears them. A new interest in trees will be roused within you. They are not dead things. They are only sleeping. Unsuspected beauties of form and color are discovered by you in winter buds. The various modes of wrapping and packing and varnishing by which the precious young shoots are protected from injury by wind and weather — all these are things that challenge your attention, and lead you into pleasures heretofore undreamed of.

Willow twig

Break off a willow twig. Its buds are pointed, and each is clothed for winter with a leathery hood, made all in one piece, and attached around the base of the bud. This leathery hood has a delicate lining membrane. There are willows and willows, but their buds all have these characteristics. The whole twig grew last summer from a single winter bud. What is the most noticeable thing about the upper and lower half of the twig? What is its significance? Willow leaves are slender and light. They leave small scars under the buds. Larger, broader leaves could not be so thickly set upon the twig without seriously interfering with each other.

Buttonwood twig

The buttonwood, which we call sycamore, makes no show of winter buds until the leaves begin to fall. You might think it an utterly improvident tree, if the swollen bases of the leaves did not tempt you to investigate. The hollow tent-like bases of the leaf stems fasten down all around the plump, conical buds. Like the willow, the sycamore bud wears a cap made of a single brown scale. Even after the leaves are fallen, one usually has no trouble in finding some buds that still wear these summer leaf caps, the petiole having broken off above them.

The bases of locust leaves cover the buds while they are growing, and when the leaves fall only the very tip is uncovered, so deeply does the bud lie buried in the stem. So with the honey locust and the Judas tree and others of the pod-bearers.

The velvety antlers of the staghorn sumac often carry

Horse Chestnut twig that blossomed last summer

over winter the bases of their youngest leaves. In spring these are loosened and pushed off by buds that are covered by them in the fashion already seen in the sycamore.

One can generally judge in winter of the size of the leaf a certain tree bears by the scar it leaves, and by the sturdiness of the twig itself. By these tokens we know that the horse chestnut has a large and heavy leaf. The dots that show so plainly on its broad triangular scar tell where fibrous bundles bound the leaf firmly to the stem. There is a dot for each leaflet. Through these vascular bundles came also the sap which fed the leaf, and back through them flowed the return currents by which each individual leaf contributed to the nourishment of the other parts of the tree.

We shall be disappointed if we expect to find a bud above each leaf scar on a horse chestnut twig. Most of the tree's energy is usually expended in forming the large terminal buds. These generally contain flowers and leaves. Side buds, one or two, are formed below to carry forward the growth of the twig which comes to an abrupt stop where flowers and fruit are borne. Then we shall find other weak side buds, formed as if to fall back upon in case of injury to the stronger ones. If no such emergency arises, these buds die.

Very fully developed and easily made out are the parts locked up in the big terminal winter buds of the horse chestnut. Outside are the bud scales, set on in pairs as are the leaves. They shingle over each other, and are weather-proof, being sealed tight with a gummy substance. When the scales are all removed we come upon the miniature leaves, folded in pairs, palms together, over a central spike of flowers. If the flowers are lacking, the number of leaves will be greater.

The twigs of the wild cherry are supple like the willow, and their buds are slender and pointed. Each is protected by overlapping scales, and sits upon a little shelf that bears the small leaf scar on its outer edge. At the base of the twig is a cluster of lines. These are the scars of the scales of last winter's bud. The accompanying twig with its five leaves and its five buds grew this season from that winter bud.

Wild Cherry twig

The gray-green downy twig of the butternut is full of character in winter. Its buds are like no others. The terminal bud

is large, containing besides a tuft of leaves the cluster of pistillate flowers. The lateral buds vary in number from one to three over each leaf scar. The lower one is usually too small to amount to anything. The two above may both be little pine-apple like bodies which are the unprotected catkins of the staminate flowers, or one may be a catkin and the other a scaly bud that has a leafy shoot wrapped up in it. The buds are borne on a shelf, under which is the leaf scar, three-lobed, with bundle scars well marked, and over it a beetling hairy ridge, like a pair of eyebrows.

Butternut twig

Very noticeable are the pungent odor, and the clammy feel of butternut twigs, and the chambered pith characteristic of all walnuts and butternuts. The black walnut buds and leaf scars somewhat resemble those of the butternut. But there is never a suggestion of hairiness or clamminess upon a black walnut twig.

Two-year-old twig of Beech

The slender winter buds of the beech are very elegantly formed. The brown scales that wrap them are thin as tissue paper, and covered with soft silken hairs. Two years of growth are shown in the picture, each of them beginning with the casting off of the bud scales whose scars form a band of considerable width on the stem. The little bud near the base of the twig is dead. While the terminal bud grew out, bearing three leaves and as many lusty buds last summer, the side bud, less favorably situated, grew a fraction of an inch, bore a leaf, and finished with a bud.

The shagbark hickory expresses well the vigor and decision of its character in its winter buds. Note the strong thick coverings that lie under the outer pair of scales. The leaves are perfectly formed inside these scales — all 's ready for the spring start, and the steady growth next summer. The prominent scar below each bud is an index to the size of the leaf that grew there.

If we examine a catalpa twig in winter we are almost sure to think that the tree is dead. The oval leaf scars stand out prominently, set at intervals in whorls of threes or in pairs about the stem. But above each scar is a mere dot. If this is a bud it must be a blighted one. What prophecy do we see of the almost tropical foliage and the great flower clusters that are the glory of these trees in

Shagbark Hickory twig

June? But the catalpa tree is not dead. About the middle of May it wakes from its winter sleep, and in an incredibly short time those tiny buds have clothed it in a luxuriance of leaf and flower that outdoes all the efforts of neighbor trees.

Have you ever opened a winter bud and counted the tiny crumpled leaves? They were made last summer and tucked away "for future reference." These miniature leaves are arranged upon their miniature stems in a definite mathematical order. Upon the position of them how much depends? For are not buds to develop later in their axils? And are not the twigs that rise from these buds to be the great boughs of succeeding years? Leaf-arrangement is intensely interesting, when we come to study it. The botanists try to scare the common folks away from it by calling it *Phyllotaxy*. But they can't keep the fun all to themselves. Let us get into their pleasant game. Here are the maples and the ashes and the buckeyes —they all have their leaves opposite. This fact is well worth remembering. A pair of leaves reaching north and south are set above (and below) a pair reaching east and west. Twigs and branches have the same arrangement. We know why. Then there is the alternate plan. Beech, sycamore, elm and basswood have two-ranked leaves, one at each joint, all lying in a horizontal plane, but alternating along the sides of the twig.

There are many ranking plans,—from twos to thirteens and up, to be found among trees. The five-ranked order is very common. The leaves are set, one at a joint, and a line joining them is a spiral that goes twice around the twig before the sixth leaf is reached directly above (or below) the one chosen as a starting point. All the common fruit trees have this order,—plum, cherry, peach, apple, pear. The flowers and often the fruits repeat the "Rule of Five;" for floral parts, the botanists say, are simply "modified leaves," which are brought into the same plane by the shortness of the stem. An apple core and a peach blossom will have more to tell us hereafter, will they not?

What does it all mean, this precision of arrangement of leaf and bud and branch? The fulfilling of the law means for each tree the best possible arrangement of its foliage, year after year. Because of this law, each leaf in its appointed place has a chance to make the most of the blessings of air, sap and sunshine it receives.

Twig of Catalpa

AN INTERESTING TREE IMMIGRANT

The Ailanthus tree, which landed here from China about one hundred years ago, has called much attention to itself ever since. I saw it first in a big city — a strange tree standing with all the stately dignity of an English elm at the head of the street. But, unlike the elm, it was clothed with foliage of tropical luxuriance, and against the fern-like leaves lay masses of half-ripe seeds, flushing pink and green, strongly resembling, at a little distance, the great flower clusters of the hardy hydrangea.

I saw Ailanthus trees next on a rough hillside — hundreds of lusty saplings. Unmindful of the protests of the lawful owner, they had seized the land, like the undaunted Tenth Legion of some mighty conqueror. On the sober conventional city tree, the average twig was no thicker than an ordinary lead pencil. But here, with the restraints of civilization removed, there was evidently going on a free-for-all race among these wild youngsters. I can easily imagine that many records were being broken, for I measured a single shoot that was eight feet long and almost two inches in diameter at its base. It bore thirty-four leaves, the largest of which was three feet six inches long, and where it broke off, the scar was easily an inch in length. "Tree of Heaven," indeed! I never before saw a tree so aspiring. But the name the farmer calls it by is "Devil's Bush." Because he cannot contend successfully with it, he stands back and calls down maledictions on its leafy head.

A queer freak of certain of these Ailanthus shoots was the broadening and flattening of the tips and the irregular crowding of the side buds. In the branch from which the drawing was made later the tip had been severely injured, and instead of lengthening, the end curled around, and a multitude of undersized leaves rose in a very small space, forming a huge rosette. A similar crowding of

"A queer freak"

leaves produces on willow trees the familiar pine cone willow galls which are described a few pages farther on.

By these tufted Ailanthus branches I am strongly reminded of an abnormal growth we often see among the branches of willow and hackberry trees. Sometimes it is the egg of a gall insect; sometimes it is the spore of a fungus that perverts the growth of the soft tissues of a terminal shoot. Whichever is the cause, the result is the checking of the upward growth. The stem throws out side shoots in profusion, and these crowd and stunt each other, producing the matted bunch of twigs which is called a "Witches' Broom."

It is no surprise to learn that the relatives of the Ailanthus tree live in the tropics. Its exuberance of growth proclaims its racial nativity. It is the sole American representative of a family that contains twenty-seven genera and one hundred and forty-seven species. The bark of the Ailanthus is smooth and fibrous, light brown, showing paler beneath, where it breaks into furrows. In the towns, staminate trees should be cut down, as the odor of the flowers is unpleasant to all, and even distressing to people who have catarrh. Pistillate flowers have no such odor. The tree spreads freely by suckers, and the abundant seeds are winged for long flights through the air. A very popular use of the tree is to start a few and cut them back to the ground each year. Under this systematic abuse, they send up leafy shoots of great size, which form a beautiful screen of shrubbery — like a fern bed, but more lusty and so more tropical-looking.

APPLES ON WILLOW TREES

When the heart-leaved willow buds cast their leathery poke bonnets in spring, and begin to undo their bundles of young leaves, a four-winged creature wriggles itself free from its pupa case in a dead leaf at the foot of the tree, and tries its powers of flight. In the warm sunshine others of its kind are flashing their iridescent wings, and enjoying the delicious smell of budding willows. They must all agree that there is nothing that quite equals it. "A short life and a merry"—this is their motto. The days of their revelry are soon over. Just before she dies, the female lays her eggs. Selecting a specially promising leaf on a willow twig, the insect settles down upon it. To look at her in this attitude you would think she had merely stopped to rest. Not unless you knew her by name would you suspect her of another motive, least of all of carrying concealed weapons. If some one were there to tell you just in the nick of time that this is a saw-fly, you might see that a pair of slender saws were thrust back and forth out of a socket on the under side of the abdomen, and that a slit was being cut in the leaf. Into the slit the insect deftly slips an egg, and away she goes. Two or three hundred times does the saw-fly repeat this operation before her strength fails and death finally overtakes her. Her numerous progeny show many peculiarities, not the least of which is increase in the size of the egg before it hatches. The tender leaf swells and forms a gall around the young larva. By June the lump is as big as a cherry. It looks much like a red-cheeked apple. I was tempted to taste the first one I ever saw, and in so doing I found out two important things: first, that the soft white flesh of the "willow apple gall" tastes rather insipid; second, that it surrounds a central cavity which is almost filled by the body of the fat larva—white except for a pair of black eyes set in the pale brown head.

"Like a red cheeked apple"

In the late summer I found the "apples" still fresh and rosy on willow leaves. Inside was the same little *habitant*, only older and larger grown. When his appetite is sated, and the faded leaf has fallen the saw-fly larva transforms into a pupa, and lies upon the ground all winter,

exposed in its helplessness to all manner of dangers. Oh, well! There were three hundred of them. If two survive there will be no shortage of saw-flies next year, will there? Fancy the result if each of the three hundred eggs hatched and the young ones all grew up!

Nature seems most kindly disposed toward these little willow saw-flies. To live in a house whose walls yield abundant food and drink is the acme of luxury, truly. But life even in such a house is fraught with dangers. Birds mistake these galls for cherries, and many a robin, disappointed in the taste of the red berry, is pleasantly surprised and quite compensated by the juicy little grub that he finds inside of it.

There is a little snout beetle that prospects in the late spring for a place to lay her eggs. Finding a small fleshy lump on the willow leaf, she wants nothing better. She probes it with her beak, pokes in an egg, and goes her way well satisfied. Out of this egg hatches a grub that soon destroys the rightful occupant of the gall, usurps its privileges, and assumes control. The Sycophant Curculio is its name. Often, instead of a beetle, a saw-fly plays the same trick. A poor relation is this larva which stays and stays, and taking the best of everything, starves his host. This insect has been called the Beggar Saw-fly.

Our sympathies are strongly enlisted in behalf of the helpless architect and inmate of the Willow Apple Gall, who, by no fault of his own, falls into the hands of his enemies—and his relations. It is a relief to be told that all of his persecutors have enemies of their own that come into the gall after them. Nature seems to have no favorites among her creatures. The willow may prefer to have its leaves let alone by the saw-flies. The saw-fly mother knows not of the Sycophant Curculio, nor the Beggar Saw-fly. And perhaps neither of these two know until too late that there are insects whose larvæ thirst for *their* blood. But each kind keeps down the numbers of the others. It is one of Nature's ways of maintaining the insect equilibrium. It calls to mind the familiar quatrain, consoling alike to men and insects:

"Big fleas have little fleas
Upon their backs to bite 'em,
And these in turn have lesser fleas —
And so *ad infinitum*."

WHITE WILLOW

Salix alba

PINE CONES ON WILLOW TREES

"Do men gather grapes of thorns or figs of thistles?" I asked myself incredulously, — "or pine cones of willow hedges?" I was walking along a country road, on either side of which was a willow hedge. I was watching the play of the sunlight among the dancing foliage, and wondering how the willow could ever have come to be the symbol of grief. These roadside trees invited me to be in love with life, and lifted up into the air long withes to show that with fine equanimity they could rise superior to the hedge trimmer's hatchet and shears.

"Made on the pattern of a pine cone"

It was among these lusty shoots that I found a shorter one that ended abruptly in a green scaly knob. I never had seen its like before. It was at seeing this that I paused and asked myself the question. The knob was made on the pattern of a pine cone, with regular, closely overlapping scales. Pine cones on willow trees? Pliny would have allowed it, — would have set it down to illustrate the wonders made possible through the art of grafting. But I was not so easily satisfied as Pliny. I knew that the willow bore a long cluster of pods. Cutting off the twig that bore this unknown fruit, I made search for more, and got in all a dozen of them. The same cone-like knobs occurred on some heart-leaved willows that reached out to me as I crossed a bridge. They were smaller, but seemed identical in kind. Sitting down on the back porch, I selected a fair specimen, and cut it open lengthwise. My knife dragged heavily toward the tip, for the scales were tufted with a thick cottony substance. At the base was a woody core, from which all the scales appeared to rise. In the core was a hollow, and above the hollow — enclosed in the innermost set of scales — lay something that excited my curiosity to the limit. It was long and tapering and white and felt soft when I poked it with the point of my knife blade. I lifted it out, cradle and all, and parting the silk blanket, saw within a little fat white grub "with a dimple in its chin." It seemed unused to being wakened in this manner, and squirmed

a little, as a child will do in a troubled dream. But I was not considering its discomfort at that moment. "Whose baby are you? How did you get here?" I didn't expect an answer direct, so set about looking for evidence. There was no door leading into the secret chamber. The scales were entire as I took them out one by one. I must have cut through the hole in opening the cone.

Selecting a fresh specimen, I scanned the outside of twig and cone with care. One by one I removed and examined the scales. They were perfect, and in the very core lay another larva just like the first one. I couldn't wait till these creatures grew up to have the answers to my questions. They might die in infancy. And so I went to the books. There I promptly found the picture of my pine cone, and the complete story of its growth.

The gall split lengthwise shows the plump white grub in the center

It would seem that the willow sap, bitter as it is to us, suits the taste of a certain tiny midge-like fly, which belongs to a family of insects known as gall-gnats. Before the young willow shoots are well started these airy winged flies are out among them. The female selects a thrifty and ambitious terminal bud, and piercing its tender tissues, lays an egg in its very center. Out of this egg hatches the maggot which begins at once to eat the walls of the prison in which it is born. Knowing no other life, it is happy, and utterly unconscious that it is thwarting the plans of the tree in the carrying out of its own. But the twig ceases to lengthen. The leaves that were in embryo in the bud, and predestined to unfold and adorn the twig as summer comes on, are stunted and developed into broad curving scales that crowd each other until further growth is impossible. The soft silky covering of unfolding leaves is kept, a pathetic reminder of what they were and what they might have become.

When autumn comes the willow leaves fall, but these scales remain. The full-grown larva lies within its little cradle, and knows only that it has had enough to eat,—that it wants to sleep. Thus the winter passes, and the early spring brings the quiet transformation to a pupa. Out of the chrysalis and out of the end of the dry and loosened cone emerges the winged adult in the spring, to join its fellows from other cones, and with them to dance away in the warm sunshine its brief span of life. Before they die the females lay their eggs, and the story of their life is repeated in their offspring.

The cones often remain on the tree for some time after their scales

are dead and their inmates have escaped. But there are no gnats in last year's nests. Wherewithal would they be fed?

I found a strange colony life existing in some of these pine cone galls. Between the scales were many larvæ of a "guest" midge — close relative of the proper inmate. As the latter kept always to her place in the center, leaving ample and unused guest chambers between the scales — and these full of a delectable and nutritious sap — why should the intruders not occupy the space and feast on the soft, leafy scales, praising Allah for both! So reasoned the mother of fifty or sixty little pinky orange creatures which I found sleeping, each in a silken web, and each lying in a socket eaten out by him while he was yet a hungry larva.

I found in several cones the eggs, long, curved, and pencil-like, of some green grasshopper, or katydid. They lay in fours and sixes — parallel, tucked in between the scales, in no case interfering with the comfort of the "guest" larvæ, which certainly had no right to rise up against the invaders even had there been a crowding. "Squatter sovereignty" was plainly the policy of each, and neither could well complain. There seemed to be room for all, with no overlapping claims and no trouble, in this model tenement house.

THE WITCH OF THE WOODS

In the greenhouse of the Botanical Garden a wondering crowd surrounds the orange tree laden at the same time with flowers and ripening fruit. It is a startling phenomenon, setting aside the rules that govern the staid trees of orchards and gardens. Just once do I recall among familiar trees, a lapse that reminds me of the habit of the orange tree. A cluster of pale apple blossoms appeared one autumn on a slender shoot that came out of the thick trunk when the rest of the tree was burdened with ripening apples. It was a nine days' wonder in the neighborhood.

"The Witch Hazel scattering its shiny seeds"

Among forest trees, as conventional as orchard trees in their observance of calendar days, there is one little tree that is utterly erratic. It is the Witch Hazel's practice to bloom in the fall while it is scattering its ripened seeds. We may lose our faith in the Witch Hazel twig as a divining rod. We may scorn to rub Pond's Extract on our bruises. But we cannot deny that, stripped of all the virtues with which tradition has invested it, the tree still has an eerie way with it; and we can never quite get out from under the spell it casts upon us. In the late winter, the Witch Hazel stands leaning against the sturdy trunks of other trees, its limbs bare or shivering in a scant covering of faded yellow leaves. The empty capsules open their yawning mouths and one would scarcely notice the tiny cup and ball and its four shriveled ribbons with which the twigs are thickly set. One does not botanize in the woods in winter.

It must be dull for the Witch Hazel in the spring. All about it the

trees hang out their blossoms, and it is not one of them. It stands aside while the great flower pageant passes, from the aspens which lead, their furry tassels flushing red against the sky of March, till the last white petals of the hawthorn shake down upon the ground. Only green leaves clothe the barrenness of the little Witch Hazel tree and its empty pods fall, one by one. But if it feels the least bit lonesome it gives no outward sign. Its broad leaves spread in the sun, and its shoots lengthen apace. Under the foliage is a secret that is not to be revealed to the careless nor to the indifferent. The tree has larger and dearer interests than the making of leaves. Green buds as round as marbles cluster on the bases of leafy side spurs. The cup and balls so small in winter now assert themselves as gray green buttons, among the tiny buds.

"Elfin blossoms of the Witch Hazel"

On some fine autumn morning when the frost is in the air and leaves are fluttering to their final rest, the red squirrel, hiding chestnuts at the root of a tree, is startled by a sharp twinge on the ear, and a skipping near him on the leafy forest carpet that is dangerously suggestive of squirrel shot. He need not hurry away so fast. It is only the Witch Hazel bombarding him with its shiny black seeds. The frost and the sun are behind the guns. They have at last sprung the trigger that long held captive the tiny projectiles. Snap! and the capsule flies wide open. By the parting of the lips the seeds are broken loose from their attachment and thrown out with surprising force. The lining of the cells is believed to shorten and contribute to the force that throws the seed out. A friend of mine interested herself in finding out how far these seeds went. She chose an isolated tree and spread white muslin under it for some yards in four directions. The most remote of the many seeds she caught were eighteen feet from the base of the tree!

If there were witches in these days I could be sure I saw them here in their own proper places in the Witch Hazel tree, laughing in glee at the squirrel's discomfiture, tossing their yellow cap-strings, cackling and showing their toothless gums without reserve in a grin both wide and deep. Come back, Mr. Bushy-tail, and take up your task without fear. It is only the Witch Hazel's little scheme to replenish the earth by colonizing new territory,—a mode of seed dispersal that ever widens the circle of the tree's distribution.

The most cheerful things in the late autumn woods are the elfin blossoms of the Witch Hazel. On those cold days when rains come down and wash the color out of the October landscape, when the leaves fall shivering from the trees, and Nature seems at last to have lost heart and given up the game,—then it is that we humans find it hardest to be cheerful. One look at the Witch Hazel works like a charm upon us. The rain seems only to brighten the yellow of its petals. Frost comes. They are turned into crêpe, and curl up into ringlets that dance in the winds. They are satisfied with just any sort of weather. The pods are older. They seem to take life more seriously. They close their lips tightly when it rains. But let the sun come out and dry them, and they fly open one after another. It is as if they burst into laughter, in which the onlooker joins in spite of himself.

A SUGGESTION

Why don't you bring in a Witch Hazel and plant it in your shrubbery border? Look among the following facts and see if you can find a good reason why you neglect this little tree.

1. It may easily be transplanted from the wilds to the garden.

2. It grows the second year from seed, or is propagated by layers. It does best in somewhat moist, peaty or sandy soil.

3. It has handsome foliage which turns yellow in the fall.

4. Its flowering is prolonged for weeks through the season when all other shrubs are out of bloom.

5. Its flowers and fruits are beautiful and exceptionally interesting.

6. At all seasons of the year the shrub is a delightful botanical study as well as an ornament to any shrubbery border.

PART II

THE LIFE OF TREES

THE PHYSIOLOGICAL SIDE

THE SLEEP OF THE TREES

Trees are, after all, very much like folks! They sleep o' nights, they feed and drink, and thereby grow. They breathe through a kind of lungs the same life-giving oxygen, and throw off carbon dioxid. They tear their clothes, and have to mend them. In a crowd, they jostle each other, like rude boys, and the big fellows usually conquer the weaker ones. They get cuts and bruises and broken limbs; and there is a long catalogue of tree diseases, most of them catching, like the measles and the whooping-cough.

In winter, trees put on their warmest coats — a fashion set by the woodchuck and the bear — and just sleep and wait for spring! In warm weather a tree goes to sleep at sundown, and wakes up in the morning. If the sky is overcast, the tree is drowsy; if rain sets in, it goes right off to sleep. The only days that really count in a tree's calendar are the clear ones.

Have you ever seen a tree asleep?

Near my house are a number of young locusts growing. Their fern-like leaves are held in sweeping, graceful clusters up into the sunshine. But on wet days, and all through the night, those leafy twigs droop down listlessly; the leaflets fold their palms together; the whole tree is the picture of limp helplessness. It is the locust's way.

The closing of the leaflets reduces evaporation (which is a cooling process), and enables the tree to save much of its bodily heat. For a similar reason a kitten tucks its feet snugly under its body, and curls its tail around, before it takes a nap. All young and tender foliage tends thus to "cuddle down" when it is sleepy. But older and stiffer leaves can sleep sitting erect, as grown-up folks will often do.

Let me suggest that you select an elm or a maple near by, or any other tree, and watch it. Compare the night and day positions of the leaves when just opening. As they become full grown, continue your observations and comparisons. Better confine yourself to one special twig of each tree. Take up a thrifty young plant of white clover from the lawn. Get it well started in a pot. Then watch it as its leaves change at night and in the morning. It is one of the most interesting things you can have about you. Set it in a dark closet

for a while in the middle of the day. Let others enjoy these little experiments with you.

Day and night, rain or shine, trees keep breathing as steadily as you do. Should you stop you would smother and die. Just as soon and just as truly would the trees. No creature lives but needs to breathe; that is the process that keeps the living tissues in working order. The constant tearing down and building up of cells is the one condition upon which life exists. In order that there may always be nutrition at hand to rebuild the cells, and that the tree may grow in stature and strength from year to year, food must be taken in, elaborated, and stored away. It is to serve this end that the tree wakes from its winter sleep. It is for this that it rests by night and wakes so early in the morning.

"Poplar buds bursting with secrets they are soon to reveal"

Every leaf that spreads its broad, green blade into the sunshine is a laboratory devoted to the manufacture of starch. The raw materials are obtained from the air, and from the soil. The machinery is the soft green leaf-pulp. The sun furnishes the power. When the sun is gone, the starch factory shuts down. After dark there is clearing up to be done, and putting of things away. It is not an eight-hour day: work stretches from sun to sun. But there is no "night shift in the starch works" of a tree or of any other plant.

It is a surprise to many people to learn how short is the tree's growing season. By midsummer the twigs are usually as long as they are going to be. The ring of new wood is formed around the trunk. The tree begins to get ready for winter. Now this long winter vacation is not indicative of an inborn tendency toward idleness in any species of trees. It is rather a habit acquired by nearly all of them, a concession to the demands of our rigorous climate. The problem is more essentially one of water supply than of temperature.

Before July is gone the amount of water taken up by the roots has perceptibly diminished. The food supply is proportionately lessened.

The whole leaf system must be re-adjusted to the cutting off of supplies. The leaves cautiously begin to close the doors through which water was wont freely to escape. As the sap-flow from the roots grows gradually weaker, the making of starch dwindles. Cooler weather warns the tree that the tender shoots need thickened bark, and that the buds must be sealed up warm and tight. To save the leaves is out of the question, for their walls are thin. So the tree makes preparations to abandon them. It is quite worth our while to pick up a leaf now and then as it flutters to our feet during the autumn. Each one tells a most interesting bit of personal history, to any one who will carefully examine and question it. No two are alike, but all tell the same story of the withdrawal of the "leaf pulp" into the twig—a story of the thriftiness of the tree. The monotony of green gives place to patches of vivid, contrasting colors, or to dead russets. The last traces of leaf green are likely to be seen along the veins, which are the channels that drained the leaf dry of its soft living matter.

We can well understand the browns of dead leaves. They are *dead* colors. But why should other leaves "die like the dolphin," painting our autumn landscapes with the changeful splendor of sunset skies? Once we said, "It is the frost." But now we know better. The dying leaf still holds some patches of leaf green. The waxy granules gradually change to a yellow liquid which shows through the transparent leaf walls as plainly as when its elements were still green. During the summer the leaves accumulated a considerable burden of mineral substances that came up to them in the crude sap, and, being in the way, it was lodged in leaf cells, to their great disadvantage. As the leaf suffers the withdrawal of its living substance, these useless mineral deposits chemically decompose. The gradual breaking down of all the residual substances in the leaf is the true cause of the brilliant and wonderful variations of color we see in the foliage of our woods in autumn. Because these changes occur at the season when warm days and frosty nights are common, we have erroneously put the two phenomena together as cause and effect.

As the leaf "ripens," a layer of healing tissue forms between leaf and twig, and when they part, we have no reason to think that the separation is cause for regret on either side. Now the tree is ready to sleep. As the cold increases, much of the water which is within the cells of the living layer, filters through the cell walls and forms into ice crystals in the spaces outside. There is room here for the expansion due to freezing, and no danger of rupturing the delicate cell walls. The cold may for a season be severe enough to stiffen the mucilaginous

substance still left in the cells. Then the tree is in a death-like trance. But with the milder weather, the protoplasm thaws, and life stirs once more. With this explanation, one can understand how it is that trees freeze solid in winter without injury. There is an important difference between freezing and freezing to death.

Look out at the trees in these warm, showery days of early April! The frost is out of the ground, and every little root is happy. The buds are shining and swelling and bursting with secrets they are soon to reveal. The twigs are green with the rising tide of sap. The very bark, rough and dead, seems to "feel in its barrenness some touch of spring." Out-of-the-way cells give up stores of starchy, sugary substance that they have been saving all winter against this day. There is food enough and to spare for every hungry cell.

Yesterday the great buds of the poplars were sound asleep. They roused themselves and threw off their shiny scales. To-day the little gray-green leaves are trembling on every twig. To-morrow the tree will be in full leaf, bold and self-sufficient, as if it had never been bare and shivering.

The botanist dissects and analyzes and experiments. So does the chemist and the physicist. Nature has told them how some of her wonders are performed. But outside the laboratory, in the April sunshine, the sum of human knowledge seems very small. The miracle of the creation is repeating itself on every hand.

The unfathomable mystery of the coming of spring!

Mandrakes in the April woods

BITTERNUT HICKORY

Hicoria minima

HOW TREES REPRODUCE THEIR KIND

Trees seem to share with all other living things an apprehension that their race may perish from the earth. It is to prevent this calamity that they feed and breathe and grow. As soon as they are old enough they produce flowers, mature seeds, and fling them forth. Their seed-sowing is a prodigal business. Every year a thousand of their offspring die for every one that lives. But that one is quite enough. One tree is sufficient to save the race.

The forms of these seeds are a constant marvel to the intelligent observer. The wonder grows when we study the uses they serve in distributing the species. Berries and other fleshy fruits tempt birds in whose crops the seeds lodge and they are afterwards dropped in regions far remote from the parent trees. The wind transports the winged seeds. Water carries the light ones. Squirrels and other animals store nuts and acorns in pockets here. There along their runways in the fall. Many of these seeds are left to germinate wherever they chance to be dropped.

The fur of animals may carry little burs like those of the beech nut. The spiny bur of the chestnut keeps animals from getting the seed. The husk and thick, rough shell protect walnuts and butternuts from being eaten. These are some of the methods; for details, read the account of "The Flight of Seeds."

But the tree that depends entirely upon seeds as a means of reproduction is seriously handicapped in the race. It has long been known that willows and some other trees could be reproduced by putting into soil a fresh piece of a branch or twig. The power to throw out leafy shoots and roots seems to be especially active in the cambium of these trees. The discovery of this fact came by observing that twigs broken off and drifted down stream took root where they lodged. Willow stakes set into the ground grow, and hedges are soon produced. Green willow fence-posts soon grow into roadside trees.

Another way of expressing the same exuberance of vitality is seen when willows are pollarded. A branch is cut off, and the cambium forms a number of buds below the wound from which strong *watersprouts* or *suckers* grow out. Bruising the stem has the same effect. The loss of

a twig often sets the branch to pushing out dormant buds. Thus the crack willow and certain poplars cast off their catkins and push out just below them leafy side shoots to take their places. It is a common practice to cut back to stubs the long weak limbs of soft maples. A thicket of lusty shoots springs up, which in a few years, with judicious thinning, forms a strong, close, symmetrical head.

A twig drooping along the ground may strike root at a joint and form an independent plant when its connection with the main plant is severed. Raspberry canes bend over and root at the tips. So do viburnums. Roots of many trees may be cut into pieces and each produce a plant. Normally, roots have no buds, but the cutting of them may produce buds from which spring leafy shoots above ground. Many plants grow from root cuttings. The horse radish plant is so propagated. The hickory is multiplied in this way. The roots of many trees produce buds, and send up shoots, apparently without provocation. The failing of the tree's vitality seems to intensify this habit. It is a sort of life-insurance scheme. With many species of trees a fringe of suckers comes up at the junction between root and stem after the tree is cut down. A common sight is the rotting stump of a giant chestnut, around and out of which a half dozen sprouts have grown into good sized trees.

In short, many plants increase their kind by devices not at all connected with flower or fruit. Man takes advantage of these suggestions of nature Theoretically, every plant or tree may be propagated by the nurseryman from a mere slip or cutting. It is necessary only to provide the conditions favorable for growth. Some practical suggestions concerning the propagation of trees will be found in the chapter, "How Nursery Trees are Made."

WHY TREES GROW ERECT

The most casual observer must have been struck by the constancy with which the trunks of trees aim toward the zenith, never minding the slope on which they may be growing. In tapering trees like the Lombardy poplar, this is most noticeable, and in all trees whose trunks continue to the top, as do the firs, spruces and tamaracks. Less noticeably, but not less constantly, does this rule hold among the broad-crowned, diffuse trees, like the oaks and the maples. Only accident or the urgent necessity for light will cause a tree to lean in growing.

Among the most interesting phenomena of tree growth are the manifest efforts made by crippled trees to get back to the erect position. Every branch seems to have inherent in it loyalty to old traditions, established perhaps when the progenitors of all tree families, growing on the margins of old Paleozoic seas, stood up, manwise, and formally assumed dominion over the forms of plant life that groveled at their feet or looked up at them from lower levels. A tree thrown down may die of its wounds, but if it does not die it seeks to assume an erect position. As long as there is life there is aspiration!

One of these courageous trees which I know is a young one that was crippled by the fall of a neighbor. It was partially uprooted, and its top was pinned to the earth, and smothered under the shaggy crown of the larger tree. When the few roots still in the ground recovered from the shock, they took fresh hold upon the soil, and a vigorous young shoot grew out of the prostrate stem. The tree's resources seem to have been withdrawn from the doomed top and thrown into this erect branch that forms a right angle with the old trunk. It is a most remarkable sight, this prone trunk with its roots in the air and its head in the dust, and out of its trunk growing this little tree as pretty and symmetrical and vigorous to all appearances as was the original tree before dire calamity overtook it. There is something almost sublime in the patience and the courage of plants!

On a steep bank which has suffered many a land-slide grows a poplar. Once it had a station far up, but its foundations were shaken while yet its roots were shallow, and it fell headlong down the slope. Catching upon a snag, the tree stopped half-way down the wall of the gorge, and a

mass of earth accumulated upon its upturned roots. The tree was thus re-planted, head downward. Three years it has been growing. Its large branches still point down the bank, but the younger ones have turned and gone the other way. Through the framework of larger branches they have forced their way to liberty and light.

Set a basswood or a willow branch in the ground upside down, and the tree which grows from it will be perfectly normal. The buds along the sides will open and the shoots bend upward as they lengthen. The terminal bud of a young larch has been killed. A lateral branch has bent up and become the leader. Gradually the "kink" is disappearing, and the stem will soon be as straight as ever. The picture shows a lower branch on a cottonwood tree. It is a record of struggles, disappointments and final triumph. Can you read it?

Some interesting observations have been recorded on the actions of crippled trees. A storm that some years ago swept the grounds of the Iowa Agricultural Experiment Station, partially uprooted several trees. A balsam fir which was bent over by the storm was later observed by Professor Bessey to be gradually bringing its tip to the vertical position. The tender new growth was first noticed to be curving up. By slow degrees the curve moved downward to wood that was two or three years old when the storm took place. The report of these observations set other scientists to experimenting. Thomas Meehan, a prominent nurseryman and horticulturist of Philadelphia, took up a straight-stemmed, well-grown arbor vitæ, and reset it with the stem at an angle of 45° with the horizon. Soon the tip began to bend toward the vertical. In three weeks the curve had extended down to the five-year-old wood, involving three feet of the top of the tree. The tip which first became erect was thrown past the vertical by the bending below it. Gradually this tendency was corrected, and the tip was brought back into line. At the end of the season the top of the tree, seven years' growth, stood upright!

An interesting phase of the erecting habit is seen in weeping trees. The young twigs are flexible and droop helplessly at first, but they stiffen and lift themselves when they grow older. Thus the youngest growth is constantly lifted higher and held farther out from the trunk, and the crown of the tree enlarged.

The force that makes a tree grow erect must be strong enough to overcome the force of gravitation. We are likely to forget that every moment the latter force is trying to pull trees to the ground. Careful observation will see the effects of the struggle between the two contending forces. An excellent illustration is seen in the gradual bending of old branches away from the trunk. This is supposed to be

due to their weight, and to accompany the loss of vigor in the tree. Young oaks have acute angles between branch and stem. Observations show these same branches grown old to stand horizontal to the trunk and sometimes to droop. Horse chestnut trees have ascending branches when young. An old tree shows the branches curving first out, then down, then up, supporting the last few years of growth and the terminal leaves in an upright position. The upper limbs of spruce and pine trees are lifted up. Lower down the branches are horizontal. The oldest, heaviest ones, droop in decrepit attitudes, and often lie passive upon the ground.

"A record of struggles, disappointments and final triumph."

The only ones of our common trees that do not pass through these modifications of shape and position of limbs are the fastigiate trees, those of the Lombardy poplar type. It will be observed that the branches of these trees never grow large nor long. There is another influence besides gravitation which acts against the tree's aspiring tendencies. It is the wind. A careful observer has only to look at the trees of a region to learn the direction and strength of prevailing winds. It is a fascinating study from car windows, relieving many a tedious journey. It is the solitary trees which are chiefly affected. Trees in groves or forests defend each other against the winds. The reader will do well to pause here and look at the full-page plates of White Pine, Tamarack, Silver-leaved Poplar, and American Beech. They tell some interesting stories about prevailing winds. Compare the Horse Chestnut, and the White Oak, and others. These trees have grown in protected situations.

In the northern woods the forester's compass is the tree top — the soft tapering terminal shoot of hemlock and other conifers bent over by the winds. There are hundreds of them always in sight. In regions where he is acquainted he needs no better guide-posts than these. They are not all alike, and so they chart the forest for him, as familiar objects guide us on our way through the city.

Winds and the force of gravitation, however, but set off the stronger force. What is the nature of this force that makes the branch or the tree grow erect? In plain English, it is *the craving for light.* However, if you wish technical terms you may use "heliotropism" for this tendency to seek the light, and "geotropism" for the tendency of plants to obey the force of gravitation. It is the desire for light that makes trees grow tall in the forest. It is the struggle for light that makes branches lengthen, that gives the leaves farthest away from the trunk the best chance to live and make a living for the tree,— that makes the inner recesses of the tree dark and leafless.

WHY TREES DIE

"The days of our years are three score years and ten." What a trifle seems the span of human life when we compare it with the age of trees! We have seen in the east remnants of our primeval forests — trees that measure one hundred feet and more in height, with a circumference to correspond. Several species of oak, the tulip tree and the sycamore reach a hundred and fifty feet. But when we have seen the "Big Trees" of California towering to a height of three hundred feet and more, we get a larger conception of what trees may attain to in size and age. Stumps of these giant trees record from two to four thousand years of growth, and the estimated age of some living specimens is five thousand years. On the slopes of the Sierras the Douglas spruce and Lambert pine often reach a height of three hundred feet. The highest known tree is an Australian species of Eucalyptus, which occasionally comes close to five hundred feet high.

In the old world there stands to-day many a tree of gigantic stature whose age probably exceeds two thousand years — cedars of Lebanon, and giant plane trees, and oaks, and yews, and chestnuts. Imagine a tree whose trunk is thick enough to touch the curbstone on either side, if it were planted in an average city street. Then you will have some idea of the size which trees may attain to. The rings of growth, counted when one of these patriarchs dies, prove that its age has not been over estimated.

Why, indeed, should a tree die at all? Each successive year renews the organs by which life is maintained. The division of each cambium cell renews the youth of that cell. Each year multiplies the number of new feeding roots and extends new shoots, which are clothed with fresh leaves. Why, then, should not a tree live forever?

"*A tree never dies of old age!*" This declaration of Professor B. E. Fernow, formerly Chief of the Division of Forestry, U. S. Department of Agriculture, authoritatively answers our question. Theoretically, a tree may taste immortality. Practically, it accumulates infirmities with years, and death sooner or later overtakes it. A tree is a dependent creature. It may starve or die of thirst if the soil is hard or dry or impoverished under it. Caterpillars may eat its foliage. Plant

lice and scale bugs may suck its juices. Beetles may tunnel under the bark and into the wood. Under these attacks the tree is helpless. Moreover, the air is laden with the germs of tree diseases. Their name is legion, — scab, rot, blight, rust, mildew, — these are some of them. The leaves, fruit, branches, roots and wood itself — each part has a host of such enemies which lodge wherever the tree presents a vulnerable point. These germs of fungous diseases grow, and their rapid development means the destruction of the tissues of the tree.

The wind, too, is an enemy of the tree because every broken limb offers a lodging place for spores of fungi which may work down into the main stem and by slow degrees reduce it to a hollow shell. Many a large tree shattered by a storm and strewn a wreck upon the ground owes its death to the development of a wood-destroying fungus whose germ entered by way of a broken branch. It behooves us, therefore, to keep the insects and fungi from getting into our favorite trees. A few practical suggestions will be found in the chapter entitled, "Insects, Diseases and Spraying."

If one wishes to kill a large tree, the easiest way is to "girdle" it. A belt of the bark a foot wide or more is usually stripped from the base of the trunk all around. This exposes the living layer, whose cells lose their moisture through evaporation, and very soon die. The ascending sap is not necessarily disturbed, as its course lies through the newest wood. But the returning current, which habitually descends through the inner bark and cambium, is unable to bridge the girdled place. The roots, which depend upon this food sent them by the leaves, soon die of starvation. The leaves die and fall, because the disabled roots cease to send up sap from below.

Trees differ widely in tenacity of life. Some promptly die if the bark is but badly bruised. Others live, though girdled, if the inner bark adheres in places. If a tree by any such chance survives girdling, it thickens its trunk above the wound. This thickening is caused by the excess of food that accumulates from above while the wound is healing, and the means of conveying it below are yet inadequate.

This fact is turned to practical account, especially in fancy fruit culture. The spurs of grapes, for instance, are girdled when fruit is well grown to hasten and to make perfect the ripening of the cluster.

TAMARACK

Larix Americana

HOW TREES BREATHE

When we say a tree *feels* thus and so, or it *thinks* this or that, we are indulging in fancy. But when we say a tree *breathes*, we state an accepted scientific truth. There is no make-believe about it. A tree inhales oxygen and exhales carbon dioxid. Even before its life as a tree began, while yet it lay as an embryo in a dry seed, it was breathing. Else the seed could not have germinated. Breathing is a serious business. It begins with life's beginning, and lasts till its close. Night and day, winter and summer, year after year, the tree breathes. So do all other living things, plant and animal. Respiration is the fundamental operation upon which all other life functions depend.

The life of a plant or an animal resides in its living cells. They feed and grow and divide. The energy for these activities is generated by the chemical union of free oxygen with carbon. This union results in a tearing down of molecules of the cell substance. The damage to the cell is repaired by the assimilation of food, and the united carbon and oxygen in the form of carbonic acid gas passes out of the tree as waste.

The breathing of a tree is the process by which oxygen is brought into contact with its living cells and the carbon dioxid cast out. It is a simpler matter than the breathing of animals, for most of the living cells of a tree are near the surface, while in animals they are distributed through the body and the oxygen has to be sent to these cells, and the carbon dioxid removed from them, by the blood. The wood of a tree is not alive. Neither is the bark. But between wood and bark, from tip of root to tip of twig is the *cambium*, which is the living part of the tree. This living layer is ministered to (as explained in the chapter, "How Trees Feed,") and it builds new wood and bark. It lengthens the branches and the roots. It adds to the tree's diameter.

The leaves may be regarded as extensions of cambium. They have been called the lungs of the tree. It is true that oxygen enters the tree chiefly through the little openings, or doorways, called *stomates*, which are located usually on the lower surface of the leaf. On the leaves of apple trees there are estimated to be one hundred thousand of these tiny openings to the square inch. These doors admit air into the loose tissues;

thus the oxygen comes into contact with the living cells; and through these openings the carbon dioxid escapes.

The lungs of animals are not equal to their task unless helped by the skin; and the leaves of plants are not able to do the work of breathing without help. Pale dots and lines may be plainly seen on the twigs and smooth branches of most trees. These are called *lenticels*. They are openings in the young bark. By these pores oxygen gains admission to the cambium, and through them carbon dioxid escapes. The cracking of the bark usually obscures these lenticels on the trunk and older branches, but on certain smooth-barked trees, as birch and cherry, we may still see them even on the trunk. To some extent the cracking and scaling of the bark as it grows old admits air to the living cells beneath it.

Underground, the roots are active in taking oxygen from the air which is present in the porous soil. This air is not stagnant, but is in constant, if not very rapid, circulation among the particles of soil, to a moderate depth. A tree is often killed by the filling in of earth above it when the land is being graded to higher level. Also a tree may be killed by a change that keeps its roots water-soaked. Both these changes are injurious because they interfere with the breathing of the roots. The first brings death by smothering; the second, death by drowning. Coal gas leaking from pipes running among the roots often kills a tree. It is a case of choking to death.

As it has no power to move about, a tree does not need to breathe very vigorously. It consumes less oxygen in proportion to its size than an animal does, and gives out less carbonic acid gas. A young tree breathes more vigorously than an old one. In early summer the growing season is at its height; the cells are most active, and the demand for oxygen is greatest. The tree breathes deeply. In winter the activity of the cells is practically suspended, and little oxygen is needed. The tree sleeps, and its breathing is low. The day's work of a tree ends at sundown. Therefore the demand for oxygen is less by night than by day.

We often hear it said that a plant "breathes in" carbon dioxid and "breathes out" oxygen. This is inaccurate. It is true that a plant takes in carbon dioxid, but this process is *feeding*, not *breathing*. As with us, plants feed at intervals; they breathe without ceasing as long as they live. A better statement would be this: plants breathe oxygen and exhale carbon dioxid just as we do; in the process of feeding, they take in carbon dioxid and give out oxygen.

The perspiration of plants is known as *transpiration*. It is the exhalation of water, and it takes place mainly through the stomates of the leaves. The crude sap is mostly water, and the amount brought to the

leaves is in excess of the amount necessary to flow back through the cambium as digested sap, even counting out the water used in the making of starch by the leaves. Night and day the excess of water is being thrown out, though we cannot see it. It passes as an invisible vapor into the atmosphere. Just so does moisture pass out from the lungs and skin of animals continually. Cover a plant with a bell jar, and we soon see the moisture gradually accumulating on the inside of the jar. The amount of this "sweat" depends upon the leaf area of the plant. Botanists estimate that for every ounce of dry matter produced, fifteen to twenty-five pounds of water must pass through the plant. "A large oak tree may transpire one hundred and fifty gallons of water per day during the summer."

HOW TREES FEED

I have spoken of the breathing of a tree,—the means by which the free oxygen of the air is brought into contact with the living cells of the cambium. It is not easy to explain what business the oxygen has there. Nor is it easy to understand how the chemical disturbance caused by the presence of the oxygen contributes to the well-being of the tree,—is even a necessity to its life. The power to work comes only to the cell attacked by oxygen. Carbon exists in combination with other elements, notably hydrogen, oxygen and nitrogen, in the cell substance. Free oxygen induces some of the carbon to leave the other elements. The carbon and oxygen chemically unite, forming carbon dioxid. The molecules which have lost some atoms of carbon are disorganized. But the energy liberated by the oxygen's disturbance enables the cell to take in food, and so to get carbon in such amount and proportion that the disturbed chemical equilibrium is restored, the broken down molecules replaced or rebuilt, the cell made whole.

All the tree accomplishes in the way of growth depends upon the energy and the food supply of its individual cells. The activity of the oxygen supplies the energy, and the elaborated sap furnishes the food which repairs the waste caused by the oxygen, and enables the cells to grow and multiply, thereby increasing the tree's size.

The food supply comes to the cambium in a continuous descending current of rich sap that flows through the cells, furnishing them with food at all times. But it has to be made ready before it can thus be used. The raw material out of which this food is made comes to the tree from two sources,—the soil and the air. The roots absorb water and with it many substances held in solution, that may or may not be useful to the tree as food. During the growing season there is a continuous flow of this crude sap from the roots to the leaves, where it is converted into nutritious plant food. The course of this current is through the sap wood. The water which the roots take up in such quantities has, furthermore, a mechanical use in the feeding of the tree. It forms a great complex waterway which bears raw materials for food up from the roots, and carries the prepared food from the leaves down through the cambium, supplying nourishment to every cell that needs it, from

leaf to root, and storing the surplus as starch along the way in older cells. The carbon supply comes largely from the air in the form of carbon dioxid, a form unfit for cell food. The leaves receive and prepare the food for the use of the growing parts of the tree. In the leaf cells crude elements are elaborated. Carbon dioxid comes in through the open doorways of the leaf when there is less of this gas inside than outside. Where there are no doorways the gas may pass by osmosis through the cell walls. Here are granules of "leaf green" arranged around the walls or in the clear substance of the cell. Many chemical elements are present, some in simple combinations, as hydrogen and oxygen united in the form of water; others in more complex combinations.

The sunlight beats upon the leaf. Its upper wall is transparent. The granules of leaf green absorb the heat and light. Through the energy thus obtained the living leaf cells are able to dissociate the two gases that compose certain molecules of water. Some carbon and oxygen that came in from the air as carbon dioxid are also divorced. By a selective and constructive power that is past human understanding these elements are made to reunite in new proportions into new molecules. The substance formed is known as *Starch*. It is of very high complexity, containing carbon, hydrogen and oxygen. The new product changed to soluble form makes its way down through the cells of the newest bark, forming a current of nutritious sap. In this the cambium finds food to rebuild its broken molecules, to nourish and multiply its cells. Here is excess of food materials to be stored away.

In the making of starch, oxygen is left over. The amount required in a molecule of starch does not use the amount supplied by the breaking up of the molecules of water and of carbon dioxid. Hence oxygen accumulates in the cell, and under osmotic pressure passes out into the air. Leaves prepare food only in the daytime, and in the presence of sunlight. The more warmth, the more work accomplished. Moist, sunny regions produce the most luxuriant vegetation.

Symbiosis is the name applied by the physiological botanists to the mutually helpful relation that exists between the roots of certain trees and certain parasitic fungi. The delicate filamentous threads of these were formerly mistaken for root hairs. They closely enmesh the tips of the tree roots, which are destitute of root hairs. The tree being unable to absorb food from the soil, the fungi do this work, and transmit the soil water to the tree. The leaves prepare it for use. The returning sap current feeds the cambium cells from leaves to roots, and the fungi get their share. Having no leaf green, they are utterly dependent upon the tree for nutrition.

HOW TREES GROW

This is what an elm tree accomplishes in a year's work. In March there are only buds on the twigs, with a leaf scar below each one. In April the largest buds cast off their scales, and blossoms open. In May the fruit ripens and falls, while the slenderer buds open into leafy shoots. In summer these shoots lengthen. They produce leaves set close together, and as they unfold, the stems between these leaves elongate. In October the tree is bare, and the long twigs, each set with many buds, are borne at the points where in March there stood only solitary buds. The tree has added to the height and the breadth of its crown by the exact length of these new shoots. The prevalent idea that the trunk of a tree lengthens, thus carrying the bases of its branches upward, is erroneous.

Underground, the roots have made a season's growth. They have no buds, nor any regular intervals of branching, as the top has. They lengthen in the direction of least resistance. They branch where branching is possible, or necessary. They interlock and grow fast where they cross. Root hairs form a fine velvety nap for a little space just back of each root tip. These never grow into roots, but wither away as the root tip grows on and deserts them, developing new hairs as it goes.

But the tree's growth is not confined to this pushing out at its extremities. The trunk grows in thickness, though it is unable to elongate. A new layer of woody tissue and one of bark is formed each year by the cambium which lies under the bark. Each branch, out to the place where the season's shoot started, follows the same rule of increase. The roots, like the branches, grow in thickness by annual rings. In some trees, as the black ash, the yearly growths part readily, like the layers of an onion. In others, as the basswood, one can scarcely count the rings, so uniform is the texture of the woody tissue. This is what makes basswood the wood carver's delight. In oak the annual layers are distinctly marked. Each one is composed of dark porous "spring wood," gradually merging into the pale "summer wood," which has much smaller pores, and is like horn in hardness and toughness. There are several of these shaded bands to

every inch. The number of rings to the inch is a plain record of any tree's rate of growth.

A tree's growing season begins with the thawing of the ground and the warming of the air in early spring. The roots absorb water supplied to the soil by the thawing of the frozen ground, the melting of snows, and the falling of spring rains. The sap currents rise, gathering on their way to the leaves rich food materials stored during the previous summer. Because they have these resources, the swelling elm buds cast their protecting scales, throw out their blossoms, mature their fruit, and unfold their leafy shoots — all with a rapidity that is incredible. Without stored food it would be impossible for the leaves to open, for by the leaves the sap is made ready for use. Leaves take charge of the nourishment of the tree as soon as they open. As soon as it is supplied with foliage, the tree finds its growing season is fully inaugurated.

The taking in of food, its "digestion," and transportation to the cells that need it belongs to another chapter. The growth of a tree, — in height and girth, — depends upon a fundamental property of all living matter. Active well fed cambium cells have a disposition to divide. The "mother cell" gradually becomes constricted, and divides into two. They may separate, but they usually remain together. By absorbing food, each "daughter cell" grows to the size of the "mother cell." Consider what this means to the tree. A cambium cell is a thing so tiny as to be seen only under a microscope, but there are millions of them. The second division makes four out of two. Then come eight, sixteen, thirty-two, sixty-four! As long as food holds out, and other conditions remain favorable, there seems to be no limit to the possibilities of cell division.

Especially rapid is cell division in growing shoots. The tissues are soft. There is nothing woody nor inert there. The shoot is practically pith and cambium. Its cells are rich in leaf green. They need not wait for the leaves to send them food. They can prepare it unaided. The delicate epidermis is no restraint upon the entrance of carbon dioxid. The cells divide in any plane. They lengthen as well as thicken. Only at the season's close, when the tissues are ripened to resist winter cold, do they give up once for all the power to grow in length. In all older parts of the tree the bark is rigid and the wood is rigid. What chance or what use for the cambium to lengthen?

I have spoken before in emphatic denial of the common notion that the trunks of trees grow gradually in length as well as in girth. This

can be tested by driving nails into the trunk at equal distances, say a foot apart. At the end of two or three years the nails may be swallowed up to the heads by the thickening of the trunk, but they will still be a foot apart. Willow posts grow, but the wires of the fence are never drawn up and apart. Lower branches die and fall, and their stubs are covered by the bark. They are not lifted up, as the tree grows.

It will be interesting to consider the way the cambium layer forms wood and bark. Constant multiplication of cells takes place, but the thickness of the cambium proper remains constant. It is a single layer of dividing cells which are ever adding to the bark on one side and to the wood on the other. The continual accession of these cells on both sides makes a belt of wood and another of bark. These two belts form a season's growth for the trunk of a tree.

Follow a superannuated cambium cell toward the bark. It is at first a soft cell lying against the inside bark. It has almost enough vitality to divide, but not quite. Other cells constantly accumulate between it and the cambium. It is forced to give its soft contents to the stream of sap that flows downward through the inner bark. By reason of the growing ring of wood the cambium must grow larger and the bark must stretch. When it can stretch no longer it cracks, and our bark cell feels the outer air. It dries and becomes a tough bark fibre. The outer layers peel off; the inner ones are pushed out. Finally, after some years, the cell we have been following will reach the surface and be cast off with others of its own age, as a small fibre in a scale of bark.

Let us follow a cell on the other side of the cambium. It lies against the youngest fibres of the sap wood. It loses its cell contents by helping to pass crude sap from the roots to the leaves. New cells form in front of it, separating it ever farther and farther from the life of the tree. It is a fibre now, and when the main sap currents flow up through younger wood this fibre may serve as a storage cell for starch. Its walls may harden, or become dark-colored, by mineral deposits; they may thicken until little space is left inside. This is when years have elapsed, and several layers of wood lie between the abandoned cell and the cambium. It is a part of the tree's heart-wood. But it will never get dry as did the bark fibre; always there is moisture enough to saturate the walls of the wood fibres. Whoever has burned green wood knows that sap oozes out of heart wood as well as sap wood, though in less quantity. He will remember how dry the bark is, and how the most of the water stews out just under the bark — the place where the cambium is.

RED OAK

Quercus rubra

Our cell, once a part of the cambium of a sapling, is now buried in the heart of a big tree. But it has never changed its place. It is just as far from the pith as ever. But each annual layer of wood buries it deeper from the outside of the tree.

The growing season for most trees ends before mid-summer. The leaves are battered and eaten by insects. The summer droughts cut off the supply of water. The buds are to be prepared for winter; the shoots must be hardened; the new wood must be ripened. Preparation for winter takes the place of further thickening of trunk or lengthening of limb. Twigs and stems and roots are stored with food, the tree tries to take in all the nutritious parts of each leaf before it casts it off. When winter comes it generally finds the tree ready.

PART III

THE CULTIVATION OF TREES

THE PRACTICAL SIDE

THE PLANTING OF HOME GROUNDS

WHERE TO PLACE TREES AND SHRUBBERY — THE PRINCIPLES OF LANDSCAPE GARDENING APPLIED TO CITY LOTS — SUGGESTIONS FOR SCHOOL GROUNDS, PARKS, AND CEMETERIES

Have you a home of your own, set in the midst of a garden that is the work of your own hands? Do you know the joy of making that home from the beginning? Perhaps you remember the day the ground was broken and the stakes were set to locate the house. Then came the laying out of the grounds, the careful choosing of what to plant and where to plant it. It has taken years to bring the garden to its present state, — years marked with successes and failures, with discouraging interruptions, but always with the comfort expressed by the injunction: "Aye keep plantin' a tree, Jock. It 'll be growin' when ye 're sleepin'."

The Principles of Landscape Gardening. There are three principles that underlie success in the laying out of the home grounds.

1. Keep an open central lawn.
2. Plant in masses at the sides.
3. Avoid straight lines.

The First Principle. Everybody feels the appropriateness and the charm of the open lawn in front, though few may be able to say why they like it. There is eternal fitness in any mode of planting which makes the house the central figure, embowers it in green, but gives it a calm, uninterrupted outlook upon the world. The artist says: "It is the foreground of green grass that leads the eye pleasantly up to the centre of interest, and the frame of the picture is the planting on the sides." It follows, therefore, that flower beds, shrubs and trees should be kept out of the central lawn. They make the yard look small. They destroy the unity of the whole picture, as each individual bids for attention.

The Second Principle. The mass planting comes down on left and right to meet the open lawn. Each lends character to the other. The grounds are hemmed in by the border planting. The premises are made cozy and cut off from the world outside.

The Third Principle. The chief reason for avoiding straight lines is that there are so few of them in nature, especially in the outlines of woods. Geometrical figures become tiresome. Easy curves, flowing lines are restful. Straight lines demand constant vigilance; the loss of a single tree mars the beauty of the whole. In the natural style of planting slight imperfections are hidden. Plant in groups and masses, not in rows, if you wish the least trouble and expense.

Bringing in the Offscape. Cosiness and seclusion are the essential elements of a homelike place. You will naturally concentrate your thoughts upon your own lot. But there is a sense in which you may own the best part of the adjoining land without paying taxes on it. You may extend your premises to the horizon line. The hills, the lake, the valley — all the beautiful things in the landscape are yours if you will cut out vistas to them. By planting lilac bushes instead of hemlock spruces in a certain place you may leave an opening in the border that frames a lovely valley view, or a glimpse of the blue lake and distant mountain. Before you plant a single tree go over your place carefully and pick out the best things in the offscape. Then draw straight lines to them from the best rooms in the house, and avoid planting trees that will obstruct those views. Look for a distant spire, a public building, or some charming bit or fragment of nature. You can generally find a good view if you try.

"The frame of the picture is the side planting"

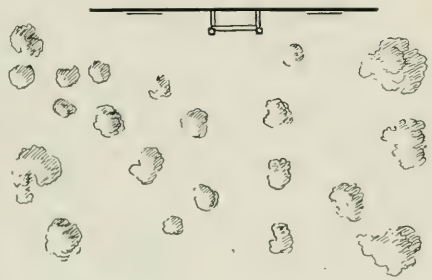
Screening Unsightly Objects. Not every prospect pleases, however. The judicious placing of a tree with dense foliage may hide a distant factory, or the giant culm heap of a coal mine, thus changing an unpleasing prospect to one of beauty. Placed near the dining-room window, a single tree that I know obscures an ugly sawmill.

The Place for the Garden. The garden and orchard should keep to the rear. They are laid out in rectangles and straight lines, so as to be cared for with the greatest economy of time and labor. All formal arrangement of flowering plants should also be retired to the back yard, where people who do not like such things will not have to see them. A geranium bed in the front yard is an abomination.

unless you abandon landscape gardening entirely, and go in for formal gardening, which is costly, troublesome and temporary. Eight months of the year your geranium bed is bare and unsightly.

The Front Yard. A wooded roadside gives us valuable hints as to the treatment of our front yard. Above, there are the crowns of large trees; smaller ones and shrubs screen the trunks completely; on the ground are flowering plants leaning and glowing rich with color against a background of foliage. This is what we want in our side planting — trees, shrubs and a border of flowers wandering along the edge of the grass in a sinuous line, which forms little bays and gentle swells, such as grace the edge of the woods.

Transplanting Trees from the Wild. How and what to plant, nature will plainly suggest. If you live near enough to choose your trees and bring them in from the woods you are indeed fortunate. You can judge by seeing how the native things grow, which ones are suited to your needs. Notice their preferences as to soil and exposure to sunlight. Such trees cost nothing except time and labor, and they contribute to the health and enjoyment of the enthusiastic planter. Perhaps you will be fortunate enough to get dogwood, magnolia, shad bush, or some other showy trees. You will find few trees more satisfactory than red maples and American elms. The native plants we set in our gardens need scarcely know they have changed places.



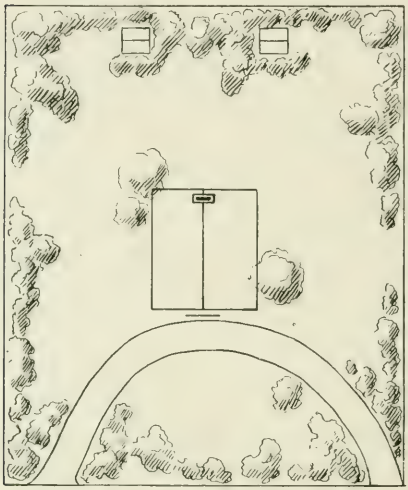
A mode of planting which spoils the picture

When to Set Trees. The best times to transplant are early spring and late fall, when the soil is mellow and the tree is dormant. But so tenacious of life are most plants that they live if only the roots are kept moist, even if moved in the growing season. Small young trees are most easily and safely transplanted. But by the perfecting of methods and mechanical contrivances large trees are now successfully transplanted. The present climax of this art or science is the moving of large evergreens in midsummer. These methods are rather costly but they give immediate results.

Showy Trees. Single trees of special beauty or interest may be planted alone, if only they keep to the side or to the back, so as not to get in the way of the outlook from the house, or obtrude themselves and

distract the attention from the center of interest. Plant showy trees and horticultural forms sparingly. Do not make your place an outdoor museum of weeping trees, cut-leaved shrubs and purple beeches.

Walks and Drives. These should be at the side and where they appear to be necessary. Though curved, they should be sufficiently direct to waste little time. Walks should skirt the central lawn, and lead one up to the house by easy, dignified curves. They should not wind, unless shrubbery is set for them to wind among. There is nothing interesting about walking in a path that simply wriggles through an open greensward. The curves beyond should be concealed by clumps of shrubbery set in the inner angles.



A scheme for the planting of school grounds

School Grounds. The planting of school grounds should be based upon the same fundamental principles as govern home planting. Where possible, a lawn in front of the school house should be kept open. Side planting of trees, in clumps or singly, with informal grouping of shrubs and flower borders, is the most artistic and economical plan. Use permanent things that are easy to care for, especially in summer. Out-buildings should be screened by clumps of shrubbery. The play-ground should be kept open. Shrubbery grouped near the school house, and flowers and ferns growing against its foundation give the place an air that is homelike and most attractive. A general representation of the native trees in a school yard gives not only a pleasing variety, but also an opportunity for pupils to become familiar with different kinds of trees, and to know each one in different seasons of the year.

Park Planting. The planting of parks is generally placed now in the hands of landscape gardeners, who reflect in their work the tendency of the age to put away formal things and to follow nature's lead. So we have but a step to go from the side where carpet-bedding and other conventional methods hold sway, to find ourselves in woodlands un-

BALSAM FIR

Abies balsamea

touched by art, unless it be art to keep the beauties of wild scenery and take away its unpleasant features.

The great parks of cities are coming to be managed with consummate skill. The small city square is necessarily formal, with its intersecting walks, its flaming beds of cannas and geraniums. For the exile from the green country who goes out of a stuffy city flat to get a breath of air in the cool of the evening, I could wish that among the elms and horse chestnuts and ailanthus trees there grew in that park one apple tree, gnarled and old, and sweet with blossoms in the spring. What a vision of days gone by! One whiff of fragrance from such a tree, one look at its blossoms, would keep me young and hopeful, I am sure, until May comes again!

The Landscape Cemetery. The planting of cemeteries is an index to the intellectual status of a community. It is always conservative, for people are loyal to traditions when they turn their minds to solemn things. There is, however, a distinct evolution visible, as one passes from the oldest toward the newest parts of cemeteries long established. In the oldest parts symbols abound. Myrtle and life-everlasting clamber over graves. Weeping forms of willows, and elms and birches bend above them. Spiry evergreens point heavenward; others clipped into grotesque shapes, invite to thoughts somber as their foliage. Rowan trees, which used to be planted to keep away evil spirits, yews, from olden time the symbol of grief, the picket fence and its padlocked gate,—all these things perpetuate ideas which are crude, and some of them even barbaric.

The race has outgrown many of its old superstitions. The new cemetery, called the "lawn," "park" or "landscape" cemetery, reflects the change. Its spirit is to solace rather than to harrow the feelings of the living. Instead of the army of gleaming obelisks, there is a marked tendency toward more modest stones, and the inconspicuous marker. The new cemetery is putting away the formal, the fantastic and the inharmonious. It will be in future a memorial park, where trees, and shrubs, and flowers are combined with all the landscape artist's skill into a park whose every line and feature shall invite to calm meditation, to pure and exalted thoughts. It will be a place where one may come out of the turmoil of a busy life, and find rest and comfort and serenity of spirit. Green grass, singing birds, flowing waters, and the breath of winds among trembling leaves—what a place to lie down and rest in, "after life's fitful fever!" Let us do what we can to make the nearest cemetery a beautiful, nature-like, attractive place, where the living will find rest and uplift of spirit.

THE PLANTING OF A TREE

Emerson said: "There is a best way of doing everything, if it be to boil an egg." If this saying be true,—and it fell from the lips of a sage,—how much care should be bestowed upon so grave a matter as the planting of a tree! Eggs are transient. Trees may taste immortality.

Most trees in cultivation are moved one or more times, in the course of their careers. This transplanting is the critical event in which many trees lose their lives. Yet it is not a difficult matter to take up and re-set a tree. Great oaks and pines are transplanted now with success even in midsummer by experts. Success in this work comes from following the few simple rules for transplanting trees that are given below.

I. *Take up as many roots as possible.* Only root tips gather food from the soil. Many of these feeding rootlets will be broken off and left in the ground in spite of our precautions.

II. *Keep the roots from drying.* Exposed to the air, the delicate root hairs shrivel and can never be revived. They are the mouths that feed the tree. Loss of a large percentage of these means starvation.

III. *Have the hole dug deep and wide.* The roots should have room to spread out naturally in all directions, To wind them around, or twist and crowd them in would mean to stunt the tree's after growth.

IV. *Trim to smooth ends all torn roots.* The healing of a ragged wound is a long and uncertain process. A smooth slanting cut soon heals, and causes no further trouble.

V. *Set the tree as deep as it was before.* The time is critical. The former depth was right. You cannot afford to try now to teach your tree new habits.

VI. *Sift fine surface soil in about the roots.* Holding the tree erect and firm, press the dirt close about the roots until they are covered. Lift the tree a little once or twice. This establishes contact between the roots and the particles of soil. Surface soil is richer and finer than that from the bottom of the hole.

VII. *Pour in water and let it settle away.* This dissolves plant food contained in the soil, and brings a supply of it to each root hair.

VIII. *Fill the hole with dirt*, tramping in each spadeful. This provides for the food supply, and makes the tree firm in its place.

IX. *Prune the top of the tree.* Transplanting prunes the roots, in spite of careful digging. The top must be reduced to correspond, or it will by transpiration overtax the maimed root system.

X. *Water the tree frequently at first.* Thorough soakings are what it needs, not light sprinklings. The roots need the water, and they are underground. Until they become established their thirst is inordinate.

XI. *Dig around the tree.* Keep the soil loose to prevent its caking and cracking. Digging the soil above them trains the roots to go deep, and frequent stirring of the fine surface soil prevents the escape of moisture from below.

After all, it is about as easy to plant a tree the right way as to plant it one of the many wrong ways. If it is worth while to plant a tree at all it is worth while to plant it well.

THE RIGHT AND THE WRONG WAY TO CUT OFF A LIMB

There is but one best way to cut off the limb of a tree, *i. e.*, to saw it off smooth and clean on a level with the surrounding bark, without leaving a projecting stub. No other tool will serve the purpose as well as a sharp saw. The proper method is shown in the accompanying picture. The cutting done, the fresh wound should be covered with some water-proof substance, like common white lead and oil.

The right way

The paint is not expected to heal the wound, nor is the wood expected to heal itself, as animal tissues are able to do. The paint serves two important purposes. (1) It prevents sap from getting out. (2) It prevents germs of decay and other foreign substances from getting in. Meanwhile, the living cambium is forming a ring of new bark around the edges of the wound, and rolling it gradually inward until it meets and closes at the center. The paint is a temporary covering, the cambium puts on the permanent one.

The secret of sound wood in growing trees is the utter exclusion of the spores of wood-destroying fungi which are so small and so light that they float invisible in the atmosphere.

There is a wrong way to cut off a limb, which, unhappily, is often practiced. The second picture shows it. That is to hack it off, leaving a long ragged stub, and to give it no further care. The wound bleeds. Evaporation robs the porous wood of its moisture. The tree diverts into other channels the sap that would have gone into this limb were it still in its place. The stub is left to die. Rain soaks into it. Dust collects in its passages. The spores of wood-destroying fungi lodge in the soil thus prepared for them. They honeycomb the stub and grow downward toward the heart of the tree.

The wrong way

Meanwhile, the cambium forms a roll of healing tissue at the base and tries to swallow the rotting stub, which becomes weakened by decay, and finally falls off of its own weight. Then the wound may close. But the disease which has gotten inside the tree may go on and reduce the trunk to a hollow shell. Or it may affect it but slightly. Rarely does a tree have a fresh wound exposed without contracting tree diseases. The larger the surface, the greater the danger, and the more urgent the necessity for the pruner to do his work well.

Sometimes the ring of healing tissue gets too thickly covered with bark. This happens only when large limbs are cut off. The ring becomes "bark-bound," and this prevents the completion of the healing process. It is a good idea to take a jack-knife and scrape off the tough, dead bark on the inner side of the ring. The cambium layer is enabled to set up growth again. This "corrective surgery" should be done in spring when the activities of the tree are at their height.

THE SPIRIT OF FORESTRY

Why is it that everybody is interested in forestry? There is an unmistakable charm in the very sound of the word. It takes hold on the imagination. You hear the word in the street car, and you look up. You see that others are interested, too. Law and medicine and theology are not words that cause the eye of the stranger to brighten. They are world-worn — they are as old as civilization. But here comes a word that we have not always known. It is a word as yet untarnished, like a new coin bright from the mint. It hints vaguely at delightful things.

Popular Conceptions of Forestry. It is always interesting to learn how various and how shadowy are the ideas people hold as to what forestry is. Ask the hunter. Forestry means to him the restriction of lumbering, so that big game may abound. Ask the dreamer. He is far away with Robin Hood and his merry men under the greenwood tree. That is the kind of forestry he cares for. Ask the student. He has chosen it for his life work. He is being educated by a technical course to help carry out the plans of the Bureau of Forestry and similar work under the Department of the Interior. To him it means position, salary, a delightful profession. Ask the statesman. Forestry, he replies, is to be one of the greatest national movements of the new century.

The Necessity for Forestry. The rational management of woodlands to serve some definite purpose: that is forestry. In Europe it has reached its highest development. In America it is yet in its infancy. Our civilization is new. We had to cut down the virgin forests to make room for it. We got into the habit of cutting down trees. We are just beginning to realize that we have carried this work too far. We see with dismay the limits set to our lumber supply. We thought it illimitable. The price of lumber is rising higher and higher. Some kinds of wood can no longer be obtained. We trace spring floods and summer droughts to the deforestation of mountain sides. To the same cause we must attribute the ever-increasing burden of soil our rivers carry to the ocean. Every year we expend more money than the last in gathering up this debris where the rivers drop it, and in dumping it out at sea. It clogs our harbors if we relax our efforts, and the pity is that the accumulation

that so endangers navigation is the best part of our soil. As civilization advances, the wooded areas recede, and we begin to realize how much we depend upon woodlands in other than material ways. Our love for trees in the abstract leads us to a personal feeling toward them — a feeling that we must champion the cause of the abused forests for their sakes and for our own.

The Three Kinds of Forestry. We have three types of forests in America. First, there is the forest maintained for a game preserve. It is a natural park, and the object of it is to minister to the æsthetic enjoyment of its owners, and to the exercise of their sporting propensities. Its management is a negative kind of forestry, whose aim is not to make it productive nor self-supporting, but to preserve natural conditions. These forests are owned by private individuals and by clubs. Many of them are to be found in the Adirondack Mountains in New York.

Second, there is the protective forest, which holds the snow and the rain, thus regulating the water supply of large areas of lower land, acting as reservoirs for irrigation systems, preventing the evils of floods, and excessive erosion of the surface. This is also a negative kind of forestry. It is adapted to steep and broken mountain regions, lands unfit for agriculture, which are the sources of important rivers. In the arid and semi-arid regions of the western states protective forestry and irrigation are the leading questions of the day.

The third type is the commercial or supply forest, the object of which is solely and emphatically the raising and harvesting of wood crops for profit. Commercial forestry is permanent and self-supporting. It requires most of the forester, and is the type which is usually understood when forestry is mentioned. Nature's resources are bent by man to the production of the best timber, in the largest possible quantities and at the least expense.

Definitions. The third kind of forestry rests upon a purely commercial basis, just as farming does. It is in reality a department of the great fundamental art of *Agriculture*, which is the improving and multiplying of useful products of the soil. *Arboriculture* is a wider term than forestry, for it takes in tree culture anywhere and for any purpose, as for example, the cultivation of fruit and ornamental trees. *Forestry* includes two branches, *Silviculture*, which is the growing of trees in forests, and *Lumbering*, which is the harvesting and marketing of wood crops. *Dendrology*, one of the sciences upon which the art of forestry is based, is chiefly the botany of trees, and is studied from three points of view. (1) The life processes of trees in health and disease, or plant physiology and pathology. (2) The minute structure of trees, which

is plant anatomy or histology. (3) The kinds of trees, which is systematic botany.

A Specific Example. It is hard to think of trees as crops, because their growing period is so much longer than that of agricultural plants. Suppose, however, we have a tract of 80,000 acres of land. We may divide it into 80 squares of 1,000 acres each. Suppose it takes 80 years to ripen a crop of trees. Every year we may harvest the crop from one-eightieth of the area and replant it. These operations will be on a scale large enough to employ a permanent force of men, and to justify the laying of a railroad. This is a crude example of the theory of rotation in economical forestry. In practice, however, there are endless modifications. The example serves to illustrate the two most important facts about forestry. (1) The forest crop requires a long time, a large scale of operations, and one continuous policy of management. (2) For these reasons, forestry is essentially a business for the government rather than for the individual.

State or Nation? There is a difference of opinion as to whether the state or national government should control in the management of large forest reserves. The old arguments come up for and against state rights on the one hand and the centralizing of government on the other. The strongest reason for national rather than state administration of forest affairs is the fact that forests spread beyond state lines, and different policies in neighboring states would have disastrous results. Further, the policy of one state might have less effect within its own limits than upon neighboring states. For instance, the stripping of mountain slopes in North Carolina might do little damage there compared with the cumulative effect such deforestation would have in South Carolina and Georgia on the lower courses of rivers rising in these mountains.

A great forest should be treated as a unit. This is impossible if it extends across the boundaries of several states, each of which has a different forest policy.

Our National Policy. The United States has laid the foundations of a great national forest policy. Some years ago there was started through the Department of Agriculture an educational movement which waked up the country on the subject of the wastefulness of past and present lumbering operations, the necessity for the checking of these excesses, and the adoption of a conservative policy. Since then the sense of the people has been expressed through the public press and has borne fruit in legislation. Nearly fifty million acres of forest land are now under government control, — set aside to be forested

BLACK WALNUT

Juglans nigra

as soon as possible by scientific methods. A tract of two million acres located in the southern end of the Appalachian mountains will probably be bought by authority of the next session of Congress and established as a forest reserve and national park. As time goes on, other areas will be bought and forested by the national government. States, corporations and individuals owning forest lands are asking advice of the Bureau of Forestry on problems of management. The Bureau sends experts to study local conditions and to outline plans for permanent and profitable enterprises.

The Forester's Training. The management of forests calls for judgment and intelligence of a high order. If a farmer makes a mistake in the choice of a crop, he can correct it the next year. A crop of trees takes the lifetime of the man to bring to harvest. The forester cannot afford to make mistakes. He should know the soil he has to deal with and the trees that will thrive best in it. He must study the lay of the land. He must know trees, their habits and rate of growth: the insects and fungous diseases that menace them. He must know these subjects in general, and study his region in particular. He must know what trees to plant together, for some valuable trees are best started under the shade of quick-growing nurse trees. He must understand lumbering in all its details. A good forester is master of many sciences, a business man of tact and ability, a man of intelligence and conscience, devoted to his work.

The Outlook. By a judicious forestry policy many of the abuses of the past years may be corrected. Trees grow. The slopes bared by forest fires, by over-grazing, or by destructive lumbering, may be reforested. Thus in time the natural regulation of the water-flow may be re-established. The beauty of wild woods will be restored if only nature is given a chance. Fish and game and birds wait only for a favorable opportunity to come again in numbers. Nature is of a forgiving temper. The ideal for forestry in America is for all the mountain sides to come into one harmonious scheme of forest management. The higher the price of lumber soars the nearer do we come to the time when rational forestry will replace mere lumbering. On the whole, the outlook is distinctly hopeful.

I am glad the English language has so beautiful and majestic a word for the still, deep woods. The forest! It is an awe-inspiring word, suggestive of forms shadowy and intangible, of sounds soft and murmuring, of odors faint but sweet as those of Araby.

A forest is not the trees alone. To the forester the word means the growing trees and everything that is tributary to their life. He counts the soil in which their roots are sunk; the litter and the leaf-mold that lie above; the trees with their roots and trunks and leafy crowns that make and thatch "the forest cover." There are all the plants that grow upon the forest floor: the shrubby things and the little tender woodland herbs, the lichens and mosses, the manifold forms of fungi that feed upon wood, and the microscopic organisms whose presence and whose life within it produce the virgin soil. There are the myriad forms of animal life that throng under the forest cover, the tiny aphids that feed upon leaves and roots and twigs, and with them all the tribes of woodland insects that lay under tribute the flowers and leaves and roots and trunks of trees. Under the leaf-mold are the earth-worms, ploughing and enriching the soil; above it are the beasts of the woods and the birds. The very atmosphere of the forest is its own, fragrant with the balm of leaves and flowers and incense-breathing mold. All these things are part and parcel of a world quite apart from things outside, — a cloistered, sacred inner world — that is the forest!

THE FARMER'S WOOD LOT

PRACTICAL FORESTRY APPLIED TO SMALL AREAS

The Problem of Unprofitable Hillsides. — There is much land in the United States that is unfit for agriculture, but there is none so poor or so dry, except in the arid regions, that it will not grow trees. A great deal of land in the eastern states has been exhausted of its fertility long ago, and does not bring returns for the labor the farmer puts upon it. There may be some sentiment but there is little sense in working year after year upon bare ridges and bleak knolls, planting them with care, only to see the crop fail. What is the matter?

Why it does not pay. — When the plow has pulverized the soil, and put it into the best possible condition, the rains come and wash the fertility out of it, and deposit it in some distant marsh, or give it to some river. The wind, too, is a thief. The particles of dust, which are the richest part of the soil, are continually being blown away and scattered over the lower lands. There is nothing to prevent this constant pillage of the soil's best treasure.

Yielding to the inevitable. — When the farmer wisely gives up the struggle, Nature steps in and works a miracle, — aye two of them. Wind-blown seeds lodge on the knolls. They grow, and among the weeds may appear a few brambles. The stubborn dead stems mat and bend over the soil in winter, resisting the wind that would tear them out by the roots. The rain by rotting the leaves and stems adds fertility to the land. Tree seeds blow in, germinate, and in a short time overshadow the other plants. Among their sapling stems leaves accumulate. The soil is firmly gripped and permeated by the roots of trees and plants. Its coarse leaf carpet becomes a spongy mat that absorbs and holds water. The tree roots go always deeper as they grow, and find plant food which the plow and the roots of most farm crops could never have reached.

Nature's double miracle. — There is little blowing and washing of the soil now. Each year it hoards fertility for the growth of the next. The trees, as saplings a beautiful part of the landscape, are becoming

a timber crop. We usually think of crops as causes of soil depletion. Yet Nature has grown a crop of trees and regenerated the soil at the same time. That is the double miracle.

Dollars and cents. — Every farmer worthy of his calling knows the value of his wood lot. In truth, he often has no more profitable land. If he doubts this, let him open an account with this tract and another with a plowed field of equal size and similar soil, and compare the figures at the end of a year.

Debits and credits. — Before he knows what profit he has made on his corn, he must deduct the value of his labor. The field was plowed, and harrowed and planted and cultivated. There is the seed to count, and the share this crop must bear in the cost of the farm implements used in its cultivation. The wood lot has had no tillage. There was no seed to buy and no labor was expended except in harvesting. Against an almost blank debit side the owner must set down the fuel, and the lumber that he was saved from buying — the poles for the shed, the fence posts, and the rails — the litter that was used to bed the cattle, or to fertilize the garden, or for both.

Incidental profits. — There are some other values which he may overlook. The wood lot is probably on land that was practically useless when Nature was given a chance to re-forest it. Now the soil is rich and deep — virgin soil, if ever he should want to clear it and add it to his fields. That piece of woods has held the snow in winter and doled the moisture out in the summer by unseen, underground ways to his crops in the lower ground instead of sending it off in surface torrents of spring rains.

Enhancing farm values. — Again, that wood lot adds greatly to the market value of the farm. A prospective buyer likes the look of it. It adds to the beauty of the plantation. It is a part of the landscape, and the landscape is a part of every home. It may be situated so as to serve a good end in protecting the house and the garden and the orchard from cold. It may temper the force of prevailing winds.

Practical suggestions. — I have spoken of the wood lot as Nature makes it. By a little thought and effort, the owner may add greatly to its value for his purposes. Nature "plays no favorites" — she is satisfied if poplar trees can hold the field against hickories and pines. By the farmer, poplars and willows are usually counted as weeds in his wood lot. He takes them out to give other saplings a better chance. If he is short of time, he will girdle the trees, which causes the leaves to fall, and lets the sunlight in. The removal of the dead

trees should be attended to as soon as possible. Seed trees should be left standing here and there. A fine hickory will supply the children and the squirrels with nuts, and then have some left with which to plant its neighborhood with little hickories. It is good to let such a tree thus impress itself on the wood lot before it is taken out. It is a useful habit to pick up an acorn or a nut as one passes under the tree and to drop it wherever one would like to see a tree of that kind growing. If these seeds are pressed into the leaf mold with the foot they are more likely to miss detection by squirrels, and to grow. Gradually the wood lot may become a grove of hardwood trees, if one is interested and faithful in gathering and scattering seeds. They grow more slowly than the softwood trees, but they have, as a rule, greater value for the farmer's use. When they are introduced by seeds gradually from the first, the waiting time does not seem so much longer than that for the shorter-lived, quicker-growing sorts.

The thinning of trees as they grow by the cutting out of all but the most promising saplings is a labor that is amply repaid in a small area. The chafing of limbs by two neighboring trees may cost the life of both. The taking out of dead branches from trees also pays. So does the gathering of dead wood such as litters the floor of the woods. This may seem at first like unnecessary "clearing up." Yet it is in rubbish of this sort that many insects and fungous diseases destructive to trees harbor and multiply. An occasional bonfire is a good thing in many ways. Much of this litter is not to be despised when converted into stovewood.

The sugar bush. — Hard maples often add to the annual income of the farm by their yield of maple sugar. The hill maples are said to be the most productive. Each tree should be given ample room. The more thickly branched it is the more sap it has. Another source of income is the fruit of the various nut trees, — the hickories, walnuts and chestnuts.

Woods for special purposes. — By a little care the wood lot may be made an assembly of most of the native species of trees good for timber. Many are adapted to special purposes. The wood of hop hornbeam has long been counted the best for levers — the blue beech for fork handles and rake teeth. The different oaks serve various ends — the elms and ashes each have particular suitability to certain definite uses.

The uncommercial side. — Beside these material benefits, the farmer may get from his wood lot recreation and inspiration and release from cares. Here live the timid wood folk in fur and feathers. Here lurk

wild flowers and ferns and mosses unknown in the open fields. The man of sensibilities finds in his wood lot a wonderful spiritual and æsthetic uplift which comes from association with trees, especially with those that form a natural wildwood. To him and to his wife and children the wood lot is at all seasons of the year a place of mystery and delight.

Brown pennyroyal stems standing like sentinels knee deep in snow on the edge of the woods.

FRUIT TREES AT HOME

PRACTICAL SUGGESTIONS FOR CULTIVATING FRUIT TREES IN SMALL YARDS IN CITY OR VILLAGE

There is a vision wondrous fair which fills the eye of the man who sets out fruit trees in his back yard. As he tends and watches them, the vision comes ever nearer, and at last it becomes a delightful reality, — there are ruddy apples ripening among the green leaves. Other trees bear fruit after their kind. The promises of earlier years are redeemed. But the harvest is not the only reward. There is pure enjoyment in the care of young trees. Each year reveals new phases of their life stories. Each year challenges us with new problems. As if they possessed intelligence the trees respond to every change of treatment. There is no dullness in the waiting years before they bear fruit.

Have you ever planned and planted such a little garden orchard? If not, then try it. Now is a good time to begin. How much of your land is behind the house? Is there a plot fifty feet square to plant? Then you have room for a dozen fruit trees, with ample space for small fruits and vegetables among them.

Choosing the trees. What fruits are you specially fond of? You will try to get those, of course. Make out your list from the catalogue of the nearest reliable nurseryman. This is one of the best parts of the whole enterprise. There are fine flavored varieties that you particularly dote upon. Get these if they have been tried and found hardy in your locality. Let somebody with more ground test new varieties. First-class trees are a few cents higher in price than the second class. The latter are inferior, — crooked perhaps, or rough or undersized. They may outgrow these defects, — and they may not. To save the difference between the prices of first and second-class trees on a small order would be very poor economy. You cannot afford to do it. The nurseryman calls first-class all trees that are well-grown, free from blemishes, and bear the characteristics of their variety. For example, a Northern Spy should be tall and straight with a long tap root; but a Greening of the same age should be shorter, with shallow, spreading roots and angular limbs.

The proper age. People often make mistakes about the ages of the trees they plant. Peach trees should be one year old when set in their final places. Apples, pears, plums, and cherries should be two, or better, three years old. The age of a tree is reckoned from the time that the seedling stock is budded with the desired variety. The ages given above are standard ones for commercial orchards. A four-year-old apple tree is worth less than a three-year-old, and a three-year-old peach tree is not worth setting out. Many people pay fancy prices for trees older than the standard ages, expecting them to come into bearing earlier, but much of their money is wasted.

A sample order. The following list of trees was chosen and set out on a lot in central New York. The trees occupy a plot about fifty by sixty feet. In this garden there will be a good variety and a good succession of fruits from summer to winter when the trees come into bearing.

Apple.	1	Yellow Transparent . . .	Summer . . .	$0.25
"	1	Gravenstein	Fall	.25
"	1	Hubbardson Nonesuch . .	Winter . . .	.25
"	1	Hyslop Crab	Fall	.25
Pear.	1	Bartlet (Dwarf)	Summer . . .	.25
"	1	Seckel "	Fall	.25
Peach.	1	Mountain Rose	Summer . . .	.20
"	1	Elberta	Early Fall . .	.20
"	1	Crawford's Late	Late Fall . .	.20
Cherry.	1	Early Richmond	Summer . . .	.50
"	1	Black Eagle	Summer . . .	.30
Plum.	1	Burbank	Fall	.30
"	1	German Prune	Fall	.35
	13	. . . . .		$3.55

Dwarf trees. These have many advantages over standards. They occupy less room and are easier to care for in every way. If they receive good cultivation they produce larger and finer fruits, although not so many as trees of standard size. Dwarf apple and pear trees of some of the leading varieties can be procured in America from nurserymen. Dwarf trees are easy to spray, and the work of pruning and harvesting is greatly simplified because no ladder is necessary

Planting the trees. You may have your trees sent to you in the fall or in the early spring. Peach trees are better set out in the spring, as they do not ripen their wood as early in the fall as many other fruit trees. Fall planting should be done early enough for the

roots to establish themselves before winter sets in. Trees thus planted get an early growing start in the spring.

"*Heeling in.*" Trees may be heeled in at any time, *i. e.*, laid down with their roots in a trench and covered with earth. This should always be done if the trees arrive from the nursery before the soil is in good condition, or if the owner is pressed for time.

Distances apart. How far apart shall the trees be set? Ordinary apple trees at least twenty-five feet in the home garden. Thirty-five or forty feet is the orchard rule. Peaches should stand sixteen feet apart each way. Dwarf apple or pears may be as close as eight feet. Often peaches are set between apples. They are shorter-lived and are gone before the apple trees begin to shade them. To get a dozen trees on a space fifty by sixty feet you will have to set some of them near the boundary lines. This is legitimate, for your neighbors will take enough of the fruit that hangs over the fences to ease your conscience as to the fertility your trees steal from their soil.

Planting day. It is a critical time, — this day of the planting, when your stakes are set, the holes dug, and the little trees assigned to their places for better or for worse. The best way to plant a tree, with the *why* of each step is given in another chapter. It need not be repeated here. Every extra care bestowed on this planting is paid for by the extra vigor of the tree during its first growing season.

Cutting back. You may not count the tree properly planted until you have cut back its top. This is really best done before the planting. It seems a pity to "sacrifice" any of the top, — it is so thrifty looking, but heavy top pruning is the price of success in this first year of the tree's orchard life. The roots have been severely pruned in the digging. Unless the top is cut back correspondingly, the maimed roots will be overtaxed, and the life of the tree be endangered. Three or four short thick branches should be left at the top, above the single trunk. They are to be the large limbs.

Feeding the trees. The soil contains much plant food which the rootlets can find if only the earth remains mellow and moist. They cannot work their way into dry, hard clods. Trees can take their food from the soil only when it is dissolved in water. What wonder that they languish when the soil is cracked and hardened! We cannot dig down and crumble those hard clods around the roots, but we can break up those at the surface. Then rains will soak down and soften the under soil. By keeping the surface soil fine and by raking it frequently, the evaporation of moisture from below may be checked, and the roots will then go on feeding without interruption.

But there inevitably comes a time when growth is checked because the food supply runs low. The soil may be rich, but its fertility is not inexhaustible. If the trees do not do well even when you keep the soil loose and fine under them, it is probable that they are in need of plant foods: nitrogen, phosphoric acid or potash.

Commercial fertilizers. Here is a chance to test commercial fertilizers. Nitrogen will start a languishing tree into lusty growth. In the form of nitrate of soda it gives the quickest results. Phosphoric acid and potash restore the mineral elements to depleted soils.

Cover crops. A second way is less expensive than buying chemical fertilizers, but slower. It is to sow "cover crops" of rye, or clover, or beans, and to turn them under while yet green. This returns to the soil much that the plants took from it while growing, and much that they gathered from the air. The pod-bearing plants, as peas, beans, clover, and vetch, have the power to gather nitrogen from the air and to store it away in little swellings called *tubercles* along their roots as well as in the parts above ground. When these plants are turned under and decay, they give their nitrogen to the soil, along with their other constituents. The cover crop not only enriches the soil but it also holds it from washing, and improves its physical condition. Vegetable fibre added to the sand and clay that constitute the soil enables it to hold moisture like a sponge. Cowpeas and crimson clover are much lauded as cover crops, especially in the south. They are not hardy in the northern tier of states,—there rye and other grains are sown instead. They contribute less of nitrogen but more of phosphoric acid and potash, the two important mineral plant foods. Rye is particularly valuable on soddy lands where it is often at first impossible to get a stand of clover.

Pruning. Each year the tree tries to support too many branches. Its energies are dissipated. Every winter the tree top should be shaped and thinned to suit the taste of the owner. A few strong limbs saved and cut back at the tips will make a roomy, well formed, fruitful head. The subject of pruning is treated in another chapter.

Subsequent care. Fruit trees do not take care of themselves. They may survive neglect, but care is what brings good fruit and plenty of it. The fight against insect pests and fungous diseases must be waged industriously in the home garden as well as in the commercial orchard. The victory pays for all the struggle.

Grafting. There is a strange fascination about the grafting of trees —the ennobling of mongrels—the changing over of branches from one variety to another. If one of your neighbors has a variety of apple

WHITE ASH

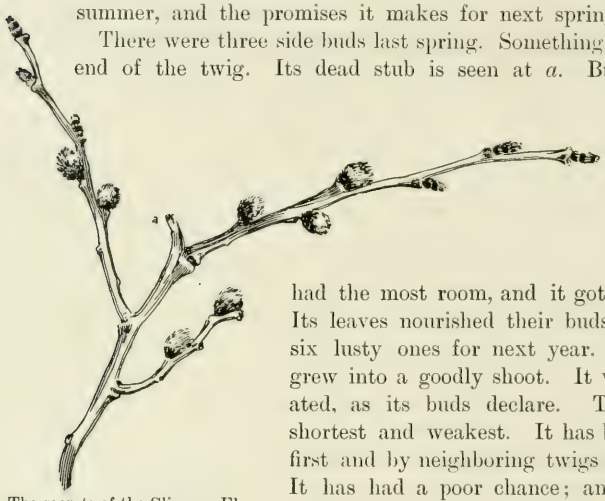
Fraxinus Americana

that you like, cut a scion in the winter time and graft it into one of your own apple trees in the spring. In course of time, you may have a dozen or more kinds growing on a single tree; — yellow apples and red, late and early, sour and sweet, — each sort on a branch that started as a scion a few years before. The wonder of such a tree never ceases, and it gives a variety of fruits otherwise unattainable in so small a garden.

The harvest. To stand under one's own trees and pluck the fruit when nature has brought it to perfection — this is the final reward of all the labor and the waiting in the home garden. The grocer's best products are not to be compared with these. To have fruit from June to June again, — some to eat from the tree, some to give away, some to put away for winter use, and some for the casual urchin to steal, — this is the dream of the gardener come true.

LEAF BUDS AND FRUIT BUDS

In winter bare twigs tell much about things past. They also tell us much about the future. I broke off the tip of a slippery elm branch that leans across the fence. Let us read the story it tells of last summer, and the promises it makes for next spring.



The secrets of the Slippery Elm buds are easy to read

There were three side buds last spring. Something had broken off the end of the twig. Its dead stub is seen at *a*. But the three buds cast their protecting scales, and grew into leafy shoots. The one farthest out made the best growth. It had the most room, and it got the most sunlight. Its leaves nourished their buds well. There are six lusty ones for next year. The second bud grew into a goodly shoot. It was very well situated, as its buds declare. The third shoot is shortest and weakest. It has been shaded by the first and by neighboring twigs on other branches. It has had a poor chance; and now its end bud and two side buds are whipped off.

What is there of prophecy in this slippery elm shoot? The lower buds are large and round; the upper ones slim and small. What means this difference? There are three ways of finding out. If you can't wait, cut the buds open with a sharp knife, or carefully take off the scales one by one and examine the inner parts with a hand lens. If you can wait a week or two, put the twig in a tumbler of water and set it in a warm place. The scales will be cast, and the secret of the buds will be out. A third way is to leave the twig where it grew and to watch the opening of the buds in spring. The clustered flowers of this elm are formed in summer, perfect but small, under thick wrappings of rusty bud scales. They are in the plump, lower buds. The leafy shoots are formed at the same time and each

one generally has its full quota of leaves for the coming summer. It is a miniature twig, enclosed in a scaly covering. These are in the slim upper buds.

The elm twig exemplifies a fashion quite common among forest and orchard trees — the bearing of well developed fruit buds and leaf buds separately on wood of the previous summer. These trees are early-blooming. They have nothing to do but to cast their bud scales in spring, and the leafy shoots and the blossoms are forced out by the food stored in the twigs for this purpose. To this class belong trees of very different families, — soft maples, poplars, willows, elms, apples, peaches, cherries. All are ready in winter to tell the thoughtful inquirer what the prospect is for fruit. We do not usually worry over the elms and maples. If their buds are few or if they winter-kill it doesn't so much matter, — to us. But the apple and pear and peach crops are important, and the plums and the cherries are anxiously watched by the careful orchardist. He wants to know all through the winter what the fruit prospect is, and he keeps an eye on the buds from fall till spring.

Three ways a peach tree bears its buds

How may we learn about these things? It is not such a complicated problem. We learn by observation and experience, as we learn other things. The looks of the buds themselves and their location on the branch are our guides in determining which are leaf and which are fruit buds. Fruit buds are almost always larger, plumper, and fuzzier than leaf buds. They are generally borne along the sides of long twigs or on short side spurs.

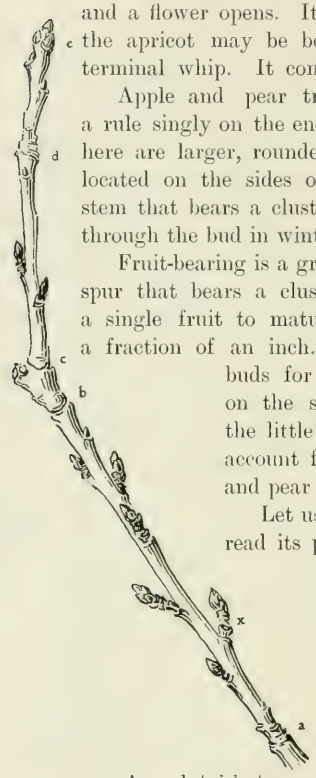
Apple, pear, plum and cherry trees as a rule bear their plump fruit buds on short side spurs, below the long end twig of the season. Apple and pear fruit buds are usually solitary and terminal on the spurs. Plums and cherries are generally clustered near the end of the spur, which produces a terminal leafy shoot.

Peaches illustrate the other arrangement. There are no spurs. Fruit buds are borne in winter singly or in twos or threes on last summer's wood. If three buds are together the middle one is a leaf bud, and the two side ones are fruit buds. If two buds stand side by side, one is a fruit bud and the other a leaf bud. The other fruit bud has been crowded off. A single bud at a joint may be a leaf bud or a fruit bud. If near the end of the twig, it is likely to be a leaf bud. The flowers tend to be more numerous and stronger toward the base. There are no proper spurs on peach trees. The little stem

by which the peach is joined to the branch bears fruit but once. Peach and apricot blossoms are simple and single. They cast their scales, and a flower opens. It is unattended by any leaf. Unlike the peach, the apricot may be borne on spurs as well as on the sides of the terminal whip. It combines the two methods.

Apple and pear trees, as I said before, bear their fruit buds as a rule singly on the ends of short twigs, called spurs. The buds borne here are larger, rounder, and more fuzzy than the leaf buds that are located on the sides of the twigs. The fruit bud contains a short stem that bears a cluster of leaves below a cluster of blossoms. A cut through the bud in winter shows all these parts in miniature.

Fruit-bearing is a great drain upon the resources of the twig. The spur that bears a cluster of a dozen flowers does well if it brings a single fruit to maturity. The bearing spur often lengthens but a fraction of an inch. It cannot ripen its fruit and produce fruit buds for the next year. Instead it makes a leaf bud on the side. Next year a leafy shoot is produced and the little stem ends in a fruit bud. This is the way to account for the alternation of years of bearing in apple and pear orchards.



An apple twig's story

Let us look at a winter apple twig and see if we can read its past and its future. It tells not so clear a story as was told by the elm twig. Four bands of scars tell of the April starting of buds into shoots. They are at *a*, *b*, *c* and *d*. The twig is apparently four years old. The shoot that started at *a* was a lusty one that grew to *b* in the season of 1898 and ended in a leaf bud. It had seven side buds, at least. In 1899, the top bud grew from *b* to *c*, where it formed a fruit bud. The side buds, all but the upper one, started, bore each a leaf or two, and ended in leaf buds, except one, which formed a fruit bud at *x*.

In 1900, a large cluster of apple blossoms opened at *c*, two of which produced fruit. A small cluster opened at *x*, and a single fruit scar shows where an apple hung. During this season the fruit matured, the spurs between *a* and *b* lengthened a little and formed terminal leaf buds, a side bud prolonging the shoot at *x*. The dormant bud below *b* remained asleep. But the strongest growth was made by the side bud that rose at *c* and ended in a leaf bud at *d*. In 1901 the spurs below grew more strongly than before, and formed plump fruit

buds for next year. Buds between *c* and *d* formed short spurs and ended in leaf buds. The top bud grows from *d* to *e* and made a good terminal fruit bud. The four-year-old apple twig formed fruit buds at the end of its second and fourth years, with a resting year between each two years of bearing. Any variation from this rule must be due to extra feeding which enables one tree to exceed the normal bearing capacity of apple trees.

Not all apple twigs will tell their story as clearly as this one does. Old trees grow very slowly, and the rings of bud scars are often so crowded that we cannot be sure of our counting. The very lusty young shoots may mislead us by a strange habit of growth, common to many other trees. The white oak twig illustrates it. Here are apparently two years of growth. But not a bud below the point *m* has started. Strong buds like these should not remain dormant for a year. Our suspicions are aroused. The explanation usually accepted is this: an early cessation of the sap-flow from the roots warned the tree to expect no more supplies. The buds formed for next spring. Later, rains came and ended the early summer drought. Sap-flow was resumed, and the terminal bud was forced into growth. It made a good start, bore leaves and matured buds before the growing season was past. This double growth in one season is often seen on apple twigs in well-tilled orchards. This oak twig was cut from a vigorous young tree.

White Oak twig showing two years' growth in one

Fruit spurs on a pear twig

The pear twig pictured here bears the promise of five flower clusters next spring. Each living spur ends in a fruit bud. The twig seems to have been six years in growing. The yearly growths started at *a*, *b*, *c*, *d*, *e* and *f*. There is a band of scale scars at each of these points. The side spur that is alive is five years old. The yearly additions on bearing twigs of pear trees are usually short and stout. Two fruits have been borne. Just below *b* and at *d* are projecting platforms where the fruit stems were attached. It is plain to be seen that this twig bears fruit in alternate years, just as the apple does. The second, fourth and now the sixth years of the twig's life are years of bearing, with the third and fifth as resting years between. The alternation of fruit and leaf buds is not an unvarying rule in twigs, nor do the various branches in a given tree, nor the trees in a given orchard

bear in alternate years only. The impulse to form fruit buds together is sufficiently strong in the twigs of individual trees, however, to cause the trees to yield alternately heavy and light crops.

When all the secrets of the early-blooming trees are out, when elm seeds are ripened and shed, and the fallen petals of orchard blossoms show that the trees have settled down to the more prosaic business of maturing their fruits—then the conservative late-blooming trees begin to show that they are alive. They open their buds, lengthen young shoots, and along the sides of these or on the ends of them the blossoms of the year are borne. Thus, basswood and the hard maples do not tell the prospects for fruit in the winter time. The development of their flowers into distinguishable form and size waits till the coming of spring. Among orchard trees, the quince illustrates this late opening habit. Hickories and walnuts and chestnuts are familiar examples among forest trees.

THE MAKING OF NURSERY TREES

THE GROWING OF SEEDLING APPLE AND PEACH TREES — BUDDING AND GRAFTING — SHAPING YOUNG TREES — MAKING DWARF TREES AND ORNAMENTALS

Thousands of nursery trees are bought and set out each year. They reach the purchaser as lusty young trees, often higher than a man. They are labeled with their proper names. Few people know what has been the life story of these trees before they left the nursery and were turned over to the tender mercies of their subsequent owners. They have passed through experiences far more thrilling than any that will come to them as they gradually grow into the stature and the dignity of bearing trees. The life story of an apple tree is representative. Let us inquire into it.

The Growing of Stocks. In the early days of apple culture in America seeds could not be had in quantities in this country, and nurserymen imported them from France. This is no longer necessary. Cider mills and similar establishments supply the home demand for seeds. These seeds are sown in drills in deep, well prepared soil, and cultivated assiduously throughout the growing season. In the fall they are little unbranched whips, from six to twelve inches high. They are dug and "heeled in" with their roots covered with earth, until the leaves "sweat off." Then they are sorted as to sizes, tied in bundles, the roots and tops are cut back, and they are stored in cellars with their roots in damp sawdust.

Many nurserymen prefer to buy these little trees rather than to raise them. The rich, deep soil of the prairie states produces most of the supply of apple stocks used by eastern nurserymen. Agents of these men go through the apple stock growing sections, buy the crop and ship it east during the winter.

Budding. If the little trees are to be budded, they are set in spring about one foot apart in nursery rows with room for a horse between the rows, for they must be given careful cultivation. They grow side branches, the roots become thicker and more numerous, and by August most of the trees are ready to bud. This means that they have a diameter of at least three-eighths of an inch at the base of the stem.

Budding is a critical process, and is usually trusted only to an expert. He has assistants that prepare the way for him, and come after to complete his work. The first step is the stripping of leaves and the clipping off of twigs for a few inches near the base of the stock. This is usually done a few days before the budder comes.

The bud and the T-shaped opening for it

It must be understood that these little trees, now two summers old, are "seedlings." Nobody knows nor cares what varieties they are. They are to be "born again" by the budding process, — their natures changed. All the nurseryman has asked of the seed is that it produce a strong stock that will be a good "nurse" to the bud and to the treetop that will grow out of that bud.

Just before the budder comes, "bud sticks" are cut from trees of desired varieties. Suppose a block of a million trees are to be converted into Baldwins. Then leafy twigs bearing well grown buds are cut from Baldwin trees. The terminal buds are too soft to use, but usually there are ten or a dozen good buds to a stick. The leaf stem is clipped off an inch above each bud. It serves a useful purpose later. Next, the buds are cut. A deft stroke almost severs a thin, oval piece of bark an inch long with the bud in the middle. Each is left hanging to the stick by a few fibers. With a bundle of these bud sticks in his capacious pocket, the budder begins his work. Dropping on one knee, he seizes the first little tree, and with two motions of his keen knife makes a T-shaped slit just through the bark, within an inch or two of the ground. By a deft turn, the tip of the knife, as it finishes the second cut, lifts the edges of the bark on each side of the wound. Clip, and a bud is cut loose from the stick. Taking it by the leaf stem which was left there on purpose for a handle, the budder slips it down under the bark. Snug in its place with the cambiums of the bud and the stock pressed close together the bud is set, and the budder goes on to repeat the simple operation on each tree that is big enough to justify it. This is *shield-budding*. A boy comes after with a bunch of raffia, or basswood fibre. He binds and ties the wound to keep out germs of tree diseases and to hold the bud and stock in contact while they unite. It takes two or three boys to tie for an expert budder, for he often sets three thousand buds a day. In a week or two the bands are cut. They are tight, and if left on would interfere with subsequent growth in thickness. The buds should have

The bud set

The bud set and tied

"stuck" by this time. The healing process is going on. The useless bands unwind, and blow away.

Cutting Back. In early spring, before growth begins, boys go through the rows and cut the tops off of the trees, leaving a few inches of stem on each above the Baldwin bud. When the bud has made a growth of an inch or two, the main stub above it is removed. Now, the nurseryman is ready to begin to count the age of his apple trees. Two or three-year-old trees in his catalogue means counting from the date the buds began to grow. Two or three seasons of growth in the nursery rows are needed to prepare the trees for customers. The first year, the bud sends up a single, leafy shoot. The next year it lengthens and branches. All its side shoots are rubbed off until the main stem is as high as the unbranched trunk of the tree should be. The next year the top is shaped, three or four shoots being left to form the main branches. All shoots starting out of the stock below where the bud was set are removed, as they would bear fruit of the mongrel, seedling type.

Grafting. Instead of budding, grafting is also practiced in the making of apple trees, and in changing them from one variety to another. It differs from budding not in kind but in degree. It consists in setting a scion, which is a twig bearing one or more buds, into the stock. The union of the cambiums of the stock and the scion is the aim of the process. Grafting is usually practiced on larger stocks, budding on smaller ones. Read "The Making-Over of Fruit Trees."

Root grafting is now very common in the making of apple trees. The prairie states produce fine, long-rooted seedling trees in a single season. These are bought in the fall, stored in cellars, and grafted at the convenience of the nurseryman during the winter. The strongest trees are made by "whole-root" grafting, wherein the scion is set in the crown (just where the root and stem join) and the whole root is left. "Piece-root" grafting is making two or three pieces of each root, and setting a scion in one end of each piece. The number of trees may thus be increased, but they are weaker and slower of growth than are the whole-rooted trees. The union of scion and stock in root-grafting is best accomplished by the *whip graft.* The ends of the scion and the stock are both cut slanting and then split in the middle for a short distance. The cleft of one is then spread by inserting the tongue of the other. The spring of the wood is by some thought to be sufficient to hold the scion in place while the parts knit together. But more commonly the union is bound. The best material is knitting cotton that has been soaked in melted wax. This does not need

to be tied, as the coils stick fast. Root grafts are packed in sand or moss till spring, when they are set in the nursery rows. It is easy to see that these trees have a year's start of the budded trees, though they began life at the same time.

Peach Trees. The fresh pits of peaches are generally laid out over winter so that the frost may crack them. They are planted in rich soil and carefully cultivated. By August they should be ready to bud, as the peach is a lusty grower. Grafting is rarely practiced on peach trees, as the wood is pithy, which makes the union of scion and graft imperfect. In the south, it is a frequent practice to bud in June peach trees from pits planted in February. It is not unusual to set out orchards of trees in the fall which have grown shoots three to five feet high from buds set the previous June. No other tree is so precocious as the peach. For orchard planting, no peach tree should be bought that is more than two years old from the pit,—one year from the bud. People who pay high prices for three-year-old peach trees, believing that they are getting trees of extra quality, are sorely cheated. Such trees are always failures, compared with the younger ones.

Dwarf Trees. If a slow-growing stock has set upon it a bud or a scion of a rapidly-growing variety, a dwarf tree is produced. The stock starves the top into conformity with its habit. Dwarf pears are made by grafting pear scions upon quince stocks. The Paradise is a little crab apple tree of France. That is the stock of most of our dwarf apple trees. Plums, cherries, and a host of ornamental trees are dwarfed.

The top is seen to exert an influence upon the root. For instance, a Northern Spy scion set on a Greening stock will change the character of the roots from the shallow, spreading system characteristic of the Greening to the strong, deep, tap-rooted system of the Spy. In dwarf trees there is a tendency to become "standard," *i. e.*, ordinary-sized, and care must be taken by the grower to keep the trees down. This may be done by pruning the roots, or by keeping them cramped in boxes or pots. In orchards, the method is to keep dwarf trees severely "headed in," *i. e.*, pruned back to a small close top. Many observations have been made, but the principles underlying the interaction between stock and scion have not yet been fully determined.

The large size sometimes attained by dwarf trees is often due to their being set so low in the ground that the stem above the scion strikes root. The top is thus supplied with roots of its own kind. The tree then gradually takes on the character of the tree from which the scion was cut.

Dwarf trees are a passion with the Japanese people. They have

WHITE POPLAR

Populus alba

forest trees centuries old growing in pots. Their gnarled and venerable forms are no larger than an ordinary potted geranium. To us, dwarfed ornamental trees are merely grotesque and interesting. Among fruit trees dwarfs tend to be more productive than standards. They take up less room, the quality of their fruit is often finer, and picking the fruit is much easier than from the larger trees. These are the reasons why they are so much grown.

Weeping Trees. Weeping elms, mountain ashes, beeches, and the rest, are generally made by grafting scions of weeping trees upon stocks of upright, closely-related varieties. They are perpetuated also by cuttings. The notion that a weeping tree is made by planting an upright one with its roots in the air and its top in the ground seems too absurd to take notice of. But it is actually believed by some people of ordinary intelligence, and very generally by the ignorant. I have also heard it said that weeping trees were the result of setting buds upside down. It would be interesting to test this by experiment.

Other Ornamentals. Variegated, cut-leaved, colored, and other forms of trees beautiful or interesting are made in the nursery just as fruit trees are: by grafting or budding, or are grown from cuttings. Some few "come true to type" from seed, but this is exceptional. Seedlings from ornamental trees are likely to be reversions to the original wild types, just as fruit trees are.

THE MAKING-OVER OF FRUIT TREES

I. CHANGING THE VARIETY

A common practice among fruit-growers is the "top-working" of well grown trees. Suppose a man has an orchard of Northern Spy apple trees several years old, and he wishes they were Greenings. It is perfectly practicable to change his trees over to the desired variety, and the process needs to take but three or four years. Let us further suppose that this man is intelligent beyond his neighbors. Then he will know that he is fortunate in having the Spys for stocks, as they are strong, straight-limbed trees which throw long tap roots straight down into the soil. This habit makes the tree firm in the ground, and enables it to find water in seasons when drought kills many shallow-rooted trees. The Spy has hard wood and smooth, close-textured bark,—both characters that enable it to resist attacks of fungous diseases and boring insects. All these are good points in a nurse tree — one which is to nurture a top of new wood and of a new variety.

The scion

Your careful orchardist will get his scions in the leisure of the winter time. He cuts lusty twigs from Greening trees that are personally known to him — healthy, well-fed trees, that bore fruit early in their lives, that bear abundantly apples that are fine in size and quality. There are Greenings and Greenings, just as there are "strains," good and poor, in the same breed of cattle. It is as reasonable to demand a record and a pedigree of one's apple trees as of one's milch cows or trotting horses.

As soon as the spring awakens the activities of the trees the top-working should be done. *Cleft grafting* is the method employed. The twigs cut in winter have been packed in moist sand or sawdust in a cellar. They are brought up, and from them the scions are cut. As in budding, the tip of the twig is usually discarded as being too soft. Each scion is a piece of twig four to six inches long that bears two or three buds. Just below the lower bud the scion is sharpened by two slanting cuts into a short blade, thicker at the back.

The owner, if he is to be Master of Ceremonies, goes into his orchard

with a pocketful of these scions. He has his grafting knife and saw, and a wooden mallet hangs from his wrist. His Man Friday follows with a ladder and a ball of grafting wax. The first step in the process of grafting is to saw off square a limb a little less than two inches in diameter. It must be a lusty one, and one that is an integral part of the natural framework of the tree. The grafting knife is now set upon the end of the stub and a smart blow with the mallet splits it. The knife is withdrawn and the hooked tip of it is then thrust into the centre of the split. This spreads the crack enough to admit the scions, one at each end of the crack. The lower bud on each scion should come just at the top of the stub; and — most important of all — *the cambium of stock and scion must be in close contact.* The scion must be set so that it meets the inner green belt of the bark. The living parts of stock and scion must grow together. This union is the "knitting," which is the aim and end of all successful grafting or budding.

Cleft grafting. The scions set.

Next, the knife point is carefully withdrawn, and the scions are held fast by the "pinch" or spring in the wood of the stub. There remains but one thing to be done — the waxing of the graft. The soft wax is made of rosin, beeswax, and tallow, melted together and kneaded or pulled like taffy until it is of the proper consistency. It is moulded about the wound, and dabbed upon the tips of the scions. This thick, close-fitting coat of wax forms an effectual waterproof protection against loss of moisture and the access of foreign substances, such as spores of fungi. Gradually this wax dries and cracks, but it usually lasts as long as there is real need of it.

Two young catalpa trees with trunks twisted form natural grafts wherever they touch.

Cleft grafting. The graft waxed

One-third of the top of each tree may be taken off the first year. The remaining two-thirds of it furnishes sufficient foliage to maintain the life of the tree. The scions grow into leafy shoots. Next year they are branched and another third can be cut off and grafted. The third spring the last of the old top comes off, and the stubs are grafted. In three years there should not be a Northern Spy leaf

upon the tree; in four or five years there should be a good crop of Greening apples to harvest.

II. THE RENOVATING OF OLD ORCHARDS

I think it must have been a Connecticut Yankee who first conceived the idea that there was money in the rejuvenation of old orchards. It must have been on some long daytime journey in New England, when the neglected and abandoned orchards flitted in rapid succession past the car window, reminding him of the hopefulness of an earlier generation, and the faithlessness of the later ones. Possibly there was no *sentiment* in his mind as the project took definite shape. *Sense* of a shrewd sort there certainly was. In the eastern states there are a few men to-day that make a good living in the following way. They rent old and neglected orchards for a term of years, put them into bearing condition, and market the fruit at a good profit. There are no new principles involved in the undertaking,—only the vigorous application of old and tried ones. Old orchards made over can never be as good as new ones carefully tended from the first. But there is a saving of time. An old tree can much more quickly be forced into profitable bearing than a nursery tree can be grown to bearing age. Trees live to great age in the eastern states. If one is not badly broken and diseased it is generally worth making over.

To succeed in this enterprise a man needs experience and capital. He must understand the care of fruit trees, and he must buy tools, hire men, and give his time to supervision and actual work. Several orchards must be rented to justify these investments. It is inspiring indeed to note the thorough-going manner in which some of these old orchards are overhauled, and to see how they take on new life. In the winter time the trees are stripped of all dead limbs, and their tops are severely cut back and thinned. They are shaped to conform to the ideals of the new husbandman. Splitting forks are clamped together, old wounds are trimmed and scraped, poulticed with grafting wax and bandaged with burlaps. Fresh wounds are covered with paint or with Bordeaux mixture. A thorough spraying with kerosene and water, or with a good resin wash, is given if scale insects are found.

With the opening of spring, work on the ground begins. The feeding of the trees is all important. The soil above and among their feeding roots must be put into the best possible physical condition, and then it must be enriched by fertilizers. It is no easy matter to tear up the

sod and to break the hard cakes of earth that encase the gnarled roots of old apple trees. The strongest plows break under the test unless the greatest caution is exercised in their management. Sometimes corn is buried with crowbars, and hogs are turned in to root for it, and thus plow the land! By any method much root-pruning is done. But the good effects outweigh the ill in these heroic measures. Tillage fits the land for holding moisture, and this moisture takes up the soil's fertility and carries it into the trees. Very often tillage, by rendering available this fertility, makes unnecessary the addition of commercial fertilizers. Oftener than not, however, the renter of orchards does not wait to see how his trees get on without help. He sprinkles some nitrate of soda, or other compound of nitrogen about their roots, and watches eagerly for results after the rain washes it into the soil. The effect is seen at once in the vigor and fine color of the new shoots.

If the varieties are to be changed, the top-working should be done as the sap rises in the spring. It is imperative that the trees be thoroughly sprayed with Paris green and Bordeaux mixture just as the buds are swelling. This is the orchardist's Golden Rule. It is his insurance against fungi and insects. This year may turn out to be the one when the bud moth does little damage; but you never can tell. If the insect appears, there is the poison which will be its effectual undoing. The wash of Bordeaux mixture destroys the spores of the fungi that would if unchecked manifest themselves in early spring.

It may be one, or it may be two or three years before these trees yield a paying crop of apples. They are years filled with hard work and thought. Spraying, pruning, tilling, fertilizing — these are operations that demand continuous industry and intelligence. Always problems arise that tax the judgment of the superintendent. For instance, over-feeding sets trees to excessive wood-production. A zealous young manager in his anxiety to force the trees to their utmost capacity may find to his dismay that it is *forestry* rather than *fruit-raising* that he is drifting into. Again, a tree may seem to be standing still while its neighbors are growing. It is probably *bark-bound*. A slit or two made by cutting through the bark lengthwise of the trunk and the largest limbs will relieve the trouble. The widening seam will gradually be closed by healing tissue, as the tree resumes growth. Sometimes lusty trees that run all to wood may be *frightened* into bearing by girdling a limb here and there, or by taking a narrow belt of bark — not too deep — from the trunk. The instinct of race-preservation sets the tree to making seeds.

I do not begrudge the Yankee apple tree regenerator one cent

of the profits he makes. I say, rather, "May his tribe increase!" and "May others follow his good example." It is a worthy thing to turn a waste place into a garden. The neighbor folks who "kep' a-laffin' an' a-pshawin'" when he came a stranger among them and began his work now wonder at the quantity and the quality of the fruit he ships out of those erstwhile good-for-nothing orchards. There is inspiration and encouragement for them all in the success he has achieved.

It is one of the limitations of our frail humanity that we straightway forget the words of the man who tells us *how to do a thing*. But the lesson taught by the man who *does the thing before our eyes* sinks deep. We cannot forget it if we would.

THE PRUNING OF TREES

MAN'S METHOD VS. NATURE'S METHOD—SOME PRINCIPLES UNDERLYING THE PRACTICE—HOW TO PRUNE FRUIT AND SHADE TREES

In the widest sense pruning is the removal of any part of a plant for any purpose. In the first place, pruning may be performed in order to benefit remaining parts. This is pruning, as commonly defined; its object is more and better fruit or flowers. Second, a plant may be pruned to give it some desired shape; for example, the shearing of evergreen hedges. This is really *trimming*, rather than pruning. Third, a tree may be pruned in order to train it into a habit of growth which it does not naturally follow; for example, peach trees are trained like vines against south walls in England in order to produce fancy fruit in a country whose season is unfavorable for peach orchards. This is *training*, rather than pruning. The word *pruning* is commonly strained to include the removal of dead wood.

Sentiment vs. Sentimentality. It hurts some of us to see a tree cut down, or pruned. Pruning has been called *tree-murder* and *arboricide*. Those who are opposed to the use of the axe, saw or shears under any circumstances are extremists, though they may not realize it. Their feeling is not common sense, but mere sentimentality. Of course, trees are often injured by careless and excessive pruning, and this fact has led some people to jump at the conclusion that pruning is in itself a harmful practice. They say, "It is unnatural; it injures the tree."

Is pruning unnatural? In every tree top you can see that a constant struggle goes on among buds and leaves and branches. There is a never-ending contest for room and light and air. The result is the survival of the few and the failure of the many. The victory is to the strong. The ground is strewn with debris. Under the bark are pruning records in the form of knots. They are the buried stubs of all the branches that tried to grow but gave it up. In the top of the tree, dead and broken branches are found. All these are proofs that Nature prunes without mercy, sentiment or intelligence. Nevertheless, it was probably Nature's own suggestion that set man to pruning in the beginning.

Is pruning injurious? There is an amiable fallacy afloat to the effect that Nature's way is always best. It sounds well. Let us apply it to pruning. Dead and broken limbs in trees of Nature's pruning are avenues by which disease germs enter and attack the wood. Nature lets the tree and the fungi fight their battle. But man is a partisan. He defends his trees against their enemies by keeping them free from dead and lacerated limbs. When he prunes, he makes close, smooth wounds, and covers them while they heal to keep out fungi. He considers Nature's method very bad pruning.

Experience proves that trees which are properly pruned gain instead of lose in vigor and health. Trees do not suffer any shock, in the sense that animals do, from the loss of limbs. Their branches are competing individuals, rather than organs, or members that cannot be replaced. Trees have no central seat of life. They do not bleed to death. The taking off of parts leaves the rest more room and more food. It is a distinct advantage. The precaution of making clean, smooth wounds and covering them to protect against inoculation by germs of disease is all that is necessary to make pruning not only safe but beneficial. Few trees which are let alone are perfectly sound. Happily, most of their superfluous limbs die young and fall, leaving very small wounds, which close in a short time.

Some Principles of Pruning. Pruning is an old practice reduced by fruit growers to an art. It is based on a few fundamental principles. Here are some of them:

1. *Pruning of roots lessens the food supply sent to the top, and so lessens the growth of the top.* It follows, therefore, that in transplanting a tree, we should prune the top somewhat because we have pruned the roots in digging up the tree, and it is necessary to restore a certain balance between root and top.

2. *Pruning of the top invigorates the growth of the branches that remain.* The supply of sap from the roots is undiminished, hence the share of each remaining branch is greater.

3. *The removal of end buds forces out the side buds.* The main shoot cannot lengthen after its terminal bud is removed.

4. *Thinning the top lets in light and air, enabling the leaves to do more work and so increasing the vigor of the plant.*

5. *Checking of growth by removing terminal buds turns the energies of the plant toward fruit-producing.* It is a similar checking which sets an injured or a diseased tree to bearing seeds profusely.

6. *Unchecked by pruning, fruit trees tend to over-production of wood.*

7. *Summer pruning lessens the struggle among leaves and twigs, and enables the survivors to mature numerous strong fruit buds.*

8. *Winter pruning induces the production of new wood and, by thinning the buds, produces fewer but finer flowers or fruits.*

Annual Pruning. Fruit trees are many and various. So are the ideals of their owners. Modes of pruning vary to correspond. Usually, however, size and quality of fruit are more desired than numbers. Therefore, the thinning of the top in winter or early spring is very commonly practiced. A little thinning every year is preferable to heavy prunings less often, for the latter method is likely to disturb the balance, and set to wood-forming the energies that should be making fruit.

Apple trees "trimmed" to Japanese parasols

For another reason the cutting off of large limbs is bad business in pruning fruit trees. Most of the fruit is borne on the outer surface of the tree, on wood but a few seasons old. The bearing area of an apple tree, for instance, is a dome of moderate thickness supported by the trunk and the framework of large limbs, both comparatively barren of leaves and fruit. When an old limb is removed a large portion is cut out of the fruit-bearing dome. It is not uncommon to let an orchard go unpruned until the lower limbs of adjacent trees interlace. Then the owner "trims up" his trees by cutting off all limbs that touch their neighbors. Finally his trees have lost so much that their bearing tops look like Japanese parasols. If the side branches had been pinched back year by year to keep them from growing so long, this sacrifice of the lower limbs would have been unnecessary. Consider how small a crop of apples such a "trimmed" tree can bear each year, and the difficulty and the expense of picking fruit that is so far from the ground.

Heading in. There is no universal rule for pruning but this: "*Begin early in the life of the tree and keep it under control by yearly pruning.*" A man shapes his trees to his liking. If he wants low, round-

headed trees, he cuts back each season's growth. This method is known as "heading in." Dwarf trees are pruned in this manner, and all trees which it is desired to force into early bearing. To make large trees, wood production is encouraged by leaving the strongest shoots, and thinning out all weak and interfering branches. Fruit-bearing is thus deferred until a large frame is developed.

Intensive Cultivation. In this country where labor is high-priced and land is cheap, fruit trees are generally grown in orchards, and only rich people train them to supports in "espalier" fashion. In Europe where land is high-priced and labor is cheap it is very common to train the trees on walls and trellises somewhat as we train grape vines. Fruit of the highest perfection is the result of this careful training, and the high cultivation that goes with it.

Pruning is a vast and complicated subject. All that is known about pruning has been learned by experiment. If education is his aim, the amateur can get plenty of it by beginning where the race began and pruning his trees with his mind unbiased by the opinions of others. If productiveness is his object, he would better fortify himself with Bailey's "Pruning Book," or some good manual of fruit-growing. Experience is a good teacher, but her instruction comes high.

How to Prune Shade Trees. Shade trees require only such pruning as shall keep their limbs within reasonable bounds and in good health. The object is to preserve the natural form and to produce as large a tree as possible. All broken and interfering limbs should be carefully removed and the wounds covered, as has been fully directed. In other words, shade trees need only trimming and the removal of dead wood. And since trimming or shaping a tree is a matter of taste, it behooves the owner to direct such work personally, instead of leaving it to hired men, who are often ignorant, although they may claim to be "expert pruners." For the person who has only a few shade trees to take care of the suggestions above will be quite sufficient.

BUTTERNUT

Juglans cinerea

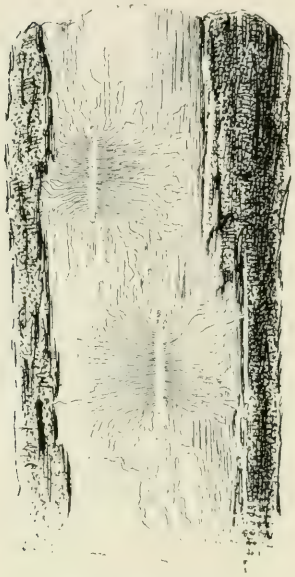
INSECTS, DISEASES, AND SPRAYING

The Rise of Spraying — The Three Classes of Injurious Insects — Modes of Combating Each — Paris Green — Kerosene and Soapy Solutions — Fungous and Other Diseases of Trees — Bordeaux Mixture — Some Notable Enemies of Trees, and the Best Modes of Controlling Them — How to Find out all about the Subject.

The Rise of Spraying. The spraying of plants is a wholesale method of destroying insects and fungi. It is one of the great discoveries of the nineteenth century. Though the whole subject is less than twenty-five years old, already a whole book has been devoted to it, and Experiment Station bulletins without number have been published. About twenty-five years ago the downy mildew of the grape crossed the ocean from America and ravaged the vineyards of France. A few years later it was accidentally discovered that copper compounds would destroy this fungus. Prior to this time no wholesale method of destroying insects or fungi was ever conceived of. Against each insect and each disease there was a special formula. In some cases dozens of remedies were proposed and many of them were preposterous. The subject was infinitely complicated, like the subject of medicine. We now know that the principles of spraying are very simple, and can be easily fixed in the mind. In fact, they can be stated in two short paragraphs.

The Destruction of Insects. Insects that feed upon plants fall naturally into two classes: those that chew and those that suck. *Chewing insects* are killed by poisoning their food. Paris green is the typical remedy for chewing insects. It is dissolved in water and sprayed upon the foliage, flowers and fruit. London purple and arsenate of lead are also much used. It is the arsenic in these compounds which poisons the insects. *Sucking insects*, as the aphids and all other true bugs, probe below the surface and draw out the juices of plants. The poisoning of their food by spraying is therefore impossible. These insects are destroyed by spraying upon their bodies soapy and oily solutions. The alkali of the soaps injures the delicate body wall, and the oil suffocates the insects by stopping their breathing pores. Kerosene-and-soap emulsions are specifics

for the destruction of sucking insects. *Boring insects*, such as make winding burrows in solid wood, or under bark, are sometimes a serious injury to trees. The locust-borer renders that tree unfit for lumber. Peach, pear and apple trees often break off at the ground, showing their wood to be honey-combed by borers. Sprays and washes may do some good in keeping away the adult insects which lay the eggs. But for the grub that does the boring nothing is so effective as a flexible wire thrust into the burrow, that surprises the miner at his toil and destroys him without mercy. A bunch of sawdust, or an exudation of wax or gum usually indicates the entrance to the burrow. The bases of fruit trees should be examined carefully at least twice a year and the borers dug out.



Burrows of engraver beetles under bark of a hickory limb

The Destruction of Fungi. Copper compounds are deadly to all germinating spores of fungi. It is said that one part of copper sulphate in ten thousand parts of water will prevent the germination of the spores of apple scab, pear leaf blight and other fungi. Bordeaux mixture is the standard remedy for fungous diseases of plants. It is made of copper sulphate diluted with milk of lime and water. The lime merely keeps the copper sulphate from burning the foliage. Fungi that attack the external parts of the plant, as downy mildew of the grape, are easily reached by spraying. Those that live within the tissues, as the anthracnose of the raspberry, are invulnerable once they become established. Their spores must be killed by contact with Bordeaux mixture sprayed upon the surfaces on which they lodge.

Combating Other Diseases. Plants are often victims of diseases caused by bacteria, which are commonly confused with fungi, though they are quite distinct. The "fire blight" of pear trees, which suddenly causes the leaves and twigs to turn brown and become shrivelled, is caused by a bacterium which enters through the growing tips and develops within the stems. There is no known remedy for bacterial diseases of plants. The affected trees should be pruned, and the diseased portions burned.

Sometimes the whole tree should be burned to prevent contagion spreading from it to healthy trees.

There are some plant diseases that so far have baffled all attempts to discover their causes. They are well exemplified by the "peach yellows," which distorts and discolors twigs, leaves, and fruit of the peach. Such of these troubles as have been proved contagious and incurable should be given heroic treatment. Affected trees should be dug out and burned. Some of the worst of these diseases seem to be due to some defect of a physiological nature, *i. e.*, they are plainly not caused by the germs of any outside organism.

The Spraying of Trees. The spraying of plants originated in Europe, but it has reached its highest development in America. From the rude heath whisk that was first used to apply Bordeaux mixture to the grape vines in France, a long line of improvements has led up to the great steam spray pump, with tank holding hundreds of gallons of liquid, and its hose and nozzles which send a fine spray through and through the top of a great tree. The perfected spray pump, under the control of an experienced operator, coats the leaves and stems with a film of the liquid, wasting little, and doing the work in an incredibly short time. But even with fine machinery, the success of spraying depends on the man. He must mix his preparations properly. In order to know what he is spraying for, and when to spray, he must understand something of the life history of the insects and fungi he is trying to combat, he must know their vulnerable points, and he must strike them at the proper moment. The typical orchard sprayer is a barrel pump, in a wagon drawn by two horses. Usually one man drives and pumps while two other men direct the nozzles and deluge the rows of trees on either side.

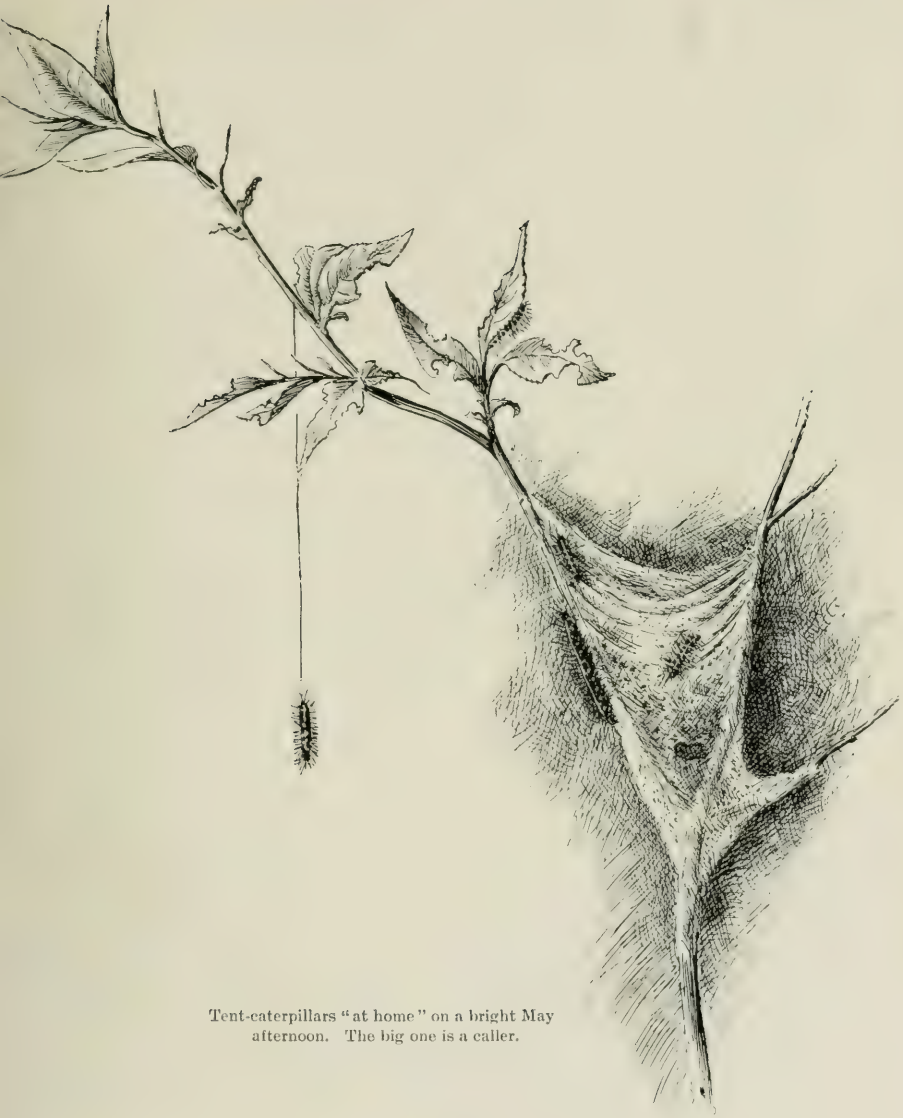
The Spraying of Shade and Ornamental Trees. As a rule shade trees are so much taller than fruit trees that the barrel pump will not force the spray high enough. The typical spraying outfit for avenue trees is therefore a small steam or gas engine, which throws a jet eighty to one hundred feet high, and costs more than the average fruit grower can afford. Park commissioners are introducing and making popular the practice of spraying city trees. We may expect that in the near future cities and towns will protect their street and dooryard trees with as much care as the fruit grower now bestows upon his orchard trees.

The Apple-tree Tent-caterpillar is a chewing insect which naturally infests the wild cherry. It has become a serious pest upon apple trees. A band of eggs covered by a dark varnish may be found on the twigs in winter time. In spring tiny caterpillars emerge and begin to feed upon the opening leaves. If undisturbed, the caterpillars go on defoliating the branch on which they hatched, and begin spinning a silken tent in which they may be found at nights and on stormy days. Grown large, they range widely over the tree, often spinning themselves down to the ground and going to other trees. The full grown caterpillar leaves the tree in early summer and spins a loose white cocoon on a fence or building, or in a curled leaf. The moth that soon emerges returns to the orchard and lays her eggs upon an apple twig to hatch the following spring.

The caterpillars are hungry and helpless for the first few days after hatching. The tree is just opening its leaves. A thorough spraying with Paris Green solution at this time is the most effective thing the fruit grower can do. After the little tents begin to show in spring, an effective method is to go through the orchard in the early morning with a long pole on the end of which is a cotton swab soaked in oil. The nests containing the inactive caterpillars are wiped out and destroyed. In the home garden, collecting the egg masses is simply and easily done when winter pruning is going on.

Scale Insects and Bark Lice lie close upon the bark of twigs and branches and on the skin of leaf and fruit. They suck the juices of the tree. The San José scale is the most dreaded of these enemies of fruit trees. In early summer the young begin to come out from the protection of the mother scale, and run about before they settle down and begin to feed and secrete a scale. While they are active the tree should be sprayed with a kerosene and water mixture or with a wash made with whale oil soap. The delicate bodies of the young insects can survive neither. In winter the half grown insects hibernate under their shells. If sprayed with kerosene emulsion many of these die of suffocation.

Scale insects may be exterminated if they are fumigated thoroughly with hydrocyanic gas. Great tents large enough to cover a tree are successfully used in California to fumigate orange trees for the San José scale. Nurserymen now have fumigating houses, where the young fruit trees are fumigated before being sent to the customer. In many states this matter is regulated by law.



Tent-caterpillars "at home" on a bright May afternoon. The big one is a caller.

The Aphids, or Plant Lice, are small sucking insects which are particularly destructive to fruit trees. They are difficult to combat. They often attack the roots as well as the parts above ground, and their multiplication is marvellously rapid. Kerosene emulsion is a sovereign specific. It is best sprayed on in early spring when the aphids are few, and the leaves are small. The notorious Phylloxera, or Grape Louse, an insect which attacks roots and vines, and has baffled all efforts to exterminate it, is an aphid. Certain American grape vines are fairly resistant to the Phylloxera, and the Old World grape vines are now being grafted on American stock.

The leaf-cutter bee has jaws as keen as sharp scissors

The Plum Curculio is the cause of wormy plums and cherries. This "Little Turk," as it is called, is the plum grower's worst enemy. It is a small snout beetle whose larva lives within the flesh of the unripe fruit. The pupa state is passed underground. It is the adult female against which war has to be waged. To spray for the curculio is almost useless, as she has a horny armor, and she probes the skin of the fruit with the tip of her long curved snout. She bores a hole in the side of the fruit, inserts one egg, and cuts a characteristic little crescent under each one. The most successful mode of combating the curculio is to jar each tree and catch the falling beetles in a hopper of canvas which is rigged upon wheels to run under the tree. A bucket containing oil swings below and the insects roll into it. This work is best done in the early morning.

The Codling-moth is the pest that causes "wormy" apples. The moths emerge from the cocoons in which they have passed the winter and the females lay their eggs on or near the little apples. The larvæ usually enter the apple at the blossom end. They feed near the core, and when full grown eat their way out through the side of the fruit. They crawl into crevices in the bark of the trunk, and there spin cocoons in which a brief pupa state is passed. The emerging moths are parents of another brood, hatched the same season. The eggs are laid upon late apples, which the larvæ feed upon and leave in late fall. Under the bark, or in the storehouses, cocoons are spun in which the larvæ hibernate, transforming to pupæ in late winter, and coming forth to lay eggs just as the apple blossoms are falling. This is the critical time for the insect and for the apple grower. The trees should at once be thoroughly sprayed with Paris green. Each little apple is held up with its calyx lobes spread;

the poison settles in the cavity at the blossom end, and here most of the young larvæ take their first meal. As the calyx lobes close soon after the blossoms fall, the poison is kept waiting for the larva. A week or ten days later a second spraying is usually given to catch belated larvæ. But the first is the critical and all-important spraying. It is estimated that it will save at least seventy-five per cent of the apples that would be wormy if the tree were not sprayed.

The Bud-moth lives over winter as a half-grown larva in a small silken case fastened to a twig. It comes forth in spring to feed upon the tender green of swelling buds. The mutilated leaves, drawn together by silk threads, form a shelter for the larva, and in this retreat the cocoon is spun. Emerging in June or July the moth lays its eggs, which hatch in a short time, and the larvæ, by feeding on the leaves, attain a considerable size before they go into hibernation. A thorough spraying with Paris green as the buds are swelling, and a second one just before the blossoms open, are fairly effectual in ridding trees of the bud-moth.

Canker-worms are the smooth-bodied "measuring-worms" that infest apple and other fruit trees. They are striped with yellow and brown, and when mature are about an inch long. They feed upon the leaves in spring, and when full grown let themselves down by threads and pupate in the ground. When the adults emerge, the wingless females crawl up the trunks and lay their eggs on the branches. The old method of combating this insect was to wrap the trunk with cotton or tarred paper to prevent the females from ascending to lay their eggs. The simpler way is to drench the tree with Paris green mixture just after the blossoms fall, so as to catch the young caterpillars just as they begin to attack the leaves.

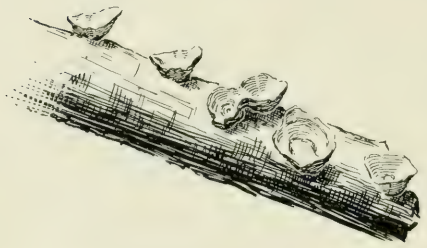
SOME INSECTS AFFECTING SHADE TREES

Shade trees and fruit trees have many insect enemies in common. There are some that are peculiar to limited groups. *Tussock-moths*, with the Gypsy moth as its most notorious type, are conspicuous enemies of shade trees in towns. The gathering and destroying of egg clusters easily seen on the trees in winter, is one means of checking the pest. Spraying with Paris green in spring destroys the larvæ. The Gypsy moth is a European insect which was imported by a scientist for purposes of study. It escaped from his care, and millions of dollars have been spent in trying to exterminate it. *The Elm-leaf Beetle* has become a serious menace to elm trees in the Hudson river valley.

SOME FUNGOUS ENEMIES OF TREES

Fungi are low forms of vegetation. As they have no leaf green, they must obtain their food by stealing from other plants which possess this substance and are able to elaborate crude sap. A typical fungus produces *spores*, exceedingly small bodies which are set free in the air. When they lodge in favorable situations they germinate, sending forth threads, called *hyphæ*, which absorb food, and multiply, forming a web called the *mycelium*. Certain parts of this organism finally develop spore-bearing organs.

Trees are "hosts" to a wonderful variety of fungi. The development of these parasites interferes with the physiological work of the living cells, and impairs the vigor of the tree. Some fungi live on the surface, some within the wood. Some infest the roots, others the parts above ground. Contact of root tips is a means of spreading some fungi. The air scatters more. Every crack or wound on the surface of a tree offers lodgment to spores that float invisible in the air.



A dead twig bearing cup fungi

Among fungous diseases of fruit trees may be mentioned *blight*, *scab*, *mildew*, *rust*, and *rot*.

The rust which appears as yellow spots on the leaves and fruit of apples in early summer illustrates the peculiar phenomenon of "alternation of generations." The spores, set free during the summer, germinate only on the cedar, producing curious fleshy "cedar apples" which develop outgrowths in which spores are borne. These spores develop only on the apple and there produce the yellow rust spots again. The destruction of cedar trees eradicates apple rust from a region. Another interesting example is afforded by aspens and larches. A certain rust that develops upon the aspen casts forth its spores which will germinate on no host but the larch. The fungus then develops into a form very unlike its parent. When it fruits, the spores will germinate only upon the aspen. Here the characteristics of the first generation reappear. The extermination of either aspens or larches will cause the fungus to disappear.

The great Shelf Fungi that grow out like brackets on the trunks of trees are signs that the tree is dying. Toadstools and mushrooms

are not the whole plants; they are simply the fruiting bodies which bear the spores. For fifty years a fungus may grow inside of a great tree. Sometimes you will find such an old tree that is full of matted mycelium which looks like felt. It is only when the tree is cut down or wounded or about to die that the fungus turns its attention to the production of spores.

How to Spray. There are no end of free pamphlets telling just how to spray plants, and especially fruit trees. Send to the agricultural college or experiment station in your state and you will get full directions. In every rural paper you will see the advertisements of dealers in spray pumps and nozzles, and if you but give these people your name and address they will deluge you with information.

PART IV

THE KINDS OF TREES

THE SYSTEMATIC SIDE

THE OAKS

"A song to the oak — the brave old oak
Who hath ruled in the greenwood long.
Here's health and renown to his broad green crown
And his fifty arms so strong.
There's fear in his frown when the sun goes down,
And the fire in the west fades out;
And he sheweth his might on a wild midnight
When the storms through his branches shout."

The Briton can sing better than he can tell his love for the oak. It is a passion, strong and deep, come down to him by inheritance from his Druid ancestors. Centuries have not abated the intensity of his feeling; they have but softened and rationalized it. What the English oak means to the Englishman, the white oak means to the American. Each embodies the spirit of the oak family. Look out at a full grown tree as it stands bare against the winter sky. How full of character are all its lineaments! There are balance and stability in the flare of its broad base; there are strength and independence in the reach of its mighty arms. Out of life-long struggles have come the ruggedness of its branches and the fine symmetry of its broad dome. In its whole aspect are breadth and tolerance — the dignity of a patriarch, the majesty of a king. What wonder that the oak appeals to the Anglo-Saxon! Are these not traits of the Anglo-Saxon character — force, independence, steadfastness?

Flowering shoot of Scarlet Oak with two half-grown acorns

All peoples have worshiped the oak. The Greeks dedicated it to Zeus. It was the "tree of knowledge" by which Socrates swore. The impressionable Romans lifted upon it worshipful eyes, and the stolid Teutons regarded it with equal veneration. There is some of the old

pagan in each one of us, I think, for when we look upon a giant oak, a feeling of awe and reverence possesses us.

Remarkably long is the life span of the oak. It reaches across the centuries. Individual trees are still standing that are known to be a thousand years old. Tradition says that some have attained twice that age. Oaks are framed for longevity, with great breadth of top and wide range of roots. The strength and tenacity of their fibers fit them to cope with storms. Twenty years they grow before they bear an acorn, and rarely is a tree fit for lumber until it is a century old. The wood of most oaks has a timber value. In its annual rings the dark, porous spring wood alternates with the pale, horny summer wood. The broad, gleaming "mirrors" of the medullary rays make it one of the valuable ornamental woods. Wherever durability and strength are required, oak lumber is in great demand. Pity 't is that the supply has dwindled so by reason of our wastefulness in the management of forest lands.

Trunk of White Oak

The oaks compose the genus Quercus. They belong to the great natural family of the cup-bearers, Cupuliferæ. Among their relatives are the chestnut and the beech. Quercus is set apart from the others by one distinguishing trait: oaks bear acorns. "By their fruits ye shall know them."

There are about three hundred species of oaks. Fifty occur in North America; twenty or more east of the Mississippi river. New varieties are being listed from time to time, for oaks intercross. Hybrids are produced by exchange of pollen between closely related species. For instance, white and bur oaks intercross, producing offspring that differ from either parent, but show

characteristics of both. Oak forests show many trees for which the botanist has no name. The significance of these facts is that the oaks are a comparatively new family upon the earth. The inevitable struggle for existence will permit the fittest only to survive, intermediate forms will disappear, and in the far distant future the species of the oak may be as distinct, and perhaps as few, as now exist among the beeches and chestnuts.

The leaves of oaks vary greatly among the different species, and even upon a given tree. Yet one will rarely confuse them with the leaves of other trees. They are simple, alternate, and usually lobed. The flowers are distinct, both sorts on the same tree. The loose staminate catkins hang in clustered, pendulous fringes at the base of the season's shoot. The pistillate flowers are solitary or few in the axils of the new leaves.

The oaks fall into two great natural divisions — the annuals and biennials. The annuals mature their acorns in a single season; the biennials require two seasons. The annuals have only curved lines in the margins of their leaves; the biennials have their lobes ending in angles and bristly points. Types of the first group are the white, bur and chestnut oaks. Types of the second group are the black, red and pin oaks. They are known as the White Oak and Black Oak groups.

Leaf of White Oak

THE WHITE OAKS

The White Oak, *Quercus alba*, is the noblest of its race. Its bark is pale gray, scaly, and cut by shallow fissures. The twigs are dark and end in tufts of leaves. Each year several new shoots rise from the end of each twig, a fact which accounts for the density of the outer boundary of the crown in winter or summer. The leaves as they open in spring cover the tree with a shimmering veil of rose and silver. When mature, they are bright green,

lightened by pale linings. They are rather large, oval in outline, tapering to the short petiole. They are divided by deep sinuses into seven or nine finger-like lobes, fairly symmetrical on the two sides of the midrib. The lobes are rounded and often shallowly subdivided. The hairy staminate catkins hang like yellow fringe among the half-fledged twigs in May. One must look sharply to find the tiny red tongues of the pistillate flowers thrust out for pollen from the axils of the unfolding leaves. The acorns, which ripen and fall at the end of the first summer, are slender and pointed. The brown, sweet-flavored nut is seated in a shallow cup of scaly but comparatively smooth exterior. The range of the White Oak is quite general.

Leaf of Bur Oak

The Bur, or Mossy Cup Oak, *Quercus macrocarpa*, is a sturdy tree, and a picturesque one. Its "antlered arms" have not the independent reach of the white oak, and its dome is lacking in symmetry. Warty and corky ridges give the branches a most rugged and untidy look. The leaves of the Bur Oak are of the white oak type—oval, pale beneath, tapering gradually to the base. A typical leaf has rather unsymmetrical lobing, and is almost cut in two by a pair of deep wide sinuses that come near the midrib on opposite sides. The name, *macrocarpa*, refers to the acorn, which is the largest in the oak family. It is often almost hidden in a cup covered with coarse, mossy scales, with a soft fine fringe around the rim. The Bur Oak ranges from Lake Superior to the Gulf, and from the eastern seaboard to the Rocky Mountains.

The Chestnut Oak, *Quercus Prinus*, is common in the eastern states. It has dark fissured bark which is rich in tannic acid. Its oval

leaves have strong parallel ribs and wavy margins, which make them somewhat resemble the chestnut leaf. The acorn is long and tapering, borne in a cup that has a downy lining and a hard scaly exterior.

The Yellow Oak, *Quercus acuminata*, is the "Chestnut Oak" of the Mississippi valley. It has a slenderer leaf than the preceding species, a smaller acorn, and the tree itself is more slender than the chestnut oak of the east. It gets its name, "Yellow Oak," from the color of the autumn foliage.

The Chinquapin Oak, or Scrub Chestnut Oak, *Quercus prinoides*, is a shrubby tree that grows in poor soil from Massachusetts to Texas. Its leaves are coarsely toothed, and of the chestnut type.

The Swamp White Oak, *Quercus platanoides*, grows in boggy regions of the east and south. It has a low-branching head and drooping limbs. It has the habit of shedding the bark of its young branches. Under favorable conditions it attains great size and age. Its variable leaves are downy beneath, and taper like those of the chestnut oak, but they have fewer ribs and deeper indentations. The acorn, which is small and set in a thinly scaled and fringed cup, looks like a feeble imitation of the lusty fruit of the bur oak.

Acorn and leaf of Chestnut Oak

The Post Oak, *Quercus minor*, is a stocky, under-sized and rough-looking tree, whose gnarled and twiggy limbs suggest that life has always been a struggle. The thick leaves are five-lobed, the widest lobes near the apex. The tree grows in upland soils from New York to Florida and west to Texas.

In the white oak group belongs the beautiful evergreen Live Oak, *Quercus Virginiana*, of the south. It is a vigorous and stately tree, bearing myriads of dancing oval leaves, and the daintiest stalked acorns.

THE BLACK OAKS

A type of the biennial group is the Black Oak, *Quercus velutina*. It carries its half-grown acorns over winter, and ripens them the following season. Its bark is black, rough and deeply furrowed, with orange inner bark that yields the dye known to commerce as *Quercitron*. The tree grows to large size, and is distributed from Maine to Texas. Its thick, ascending branches form an open, loose head. The leaves are very

variable, sometimes distinguishable from the scarlet oak only by their coarser texture and by their stouter petioles. The average leaf is widest toward the apex, its five lobes subdividing and terminating in bristly points, which are the ends of the ribs. These bristles are generally whipped off before the end of the season. The opening leaves are red and velvety above and downy white underneath. They keep some traces of their downy lining all summer, while the upper surfaces are shiny and dark green. In autumn they change to russets and dull reds. The stout twigs and pointed brown buds are covered in winter with a rusty wool. The acorn of the Black Oak is pointed and deeply set in a cup covered with loose pointed scales that do not tighten nor round inward at the rim. Its kernel is bitter and yellow.

Trunk of Black Oak

The Scarlet Oak, *Quercus coccinea*, is so named from the brilliancy of its autumn foliage. The flowers hint at the same thing, and the unfolding leaves are of a rosy hue. The leaves are thin and smooth, and cut by deep rounded sinuses. The five to seven lobes end each in two or more bristly points. The acorn is like that of the black oak, except that the scales of its cup are close, and round in at the top, and its kernel is white. The bark is gray outside and reddish underneath. The Scarlet Oak is beautiful at all seasons. It is a favorite ornamental tree in America and Europe.

The Red Oak, *Quercus rubra*, is one of the most stately of the oaks. It has a wide horizontal spread, and forms a rounded, dome-like top. Its wood is coarse, and reddish brown; its bark smooth, brownish gray, with a tinge of red in it. The leaves, which are variable in outline, always

BLACK OAK

Quercus velutina

Leaf and fruit of Scarlet Oak

have triangular lobes that point in the direction of the tip, differing, as is plainly seen, from the leaves of the black and scarlet oaks. The number of lobes is seven or nine. The leaves are thin, and smooth on the lower surface. They come out pink in spring, with white down beneath. They turn in autumn to a fine dark red, or to various shades of russet. The large acorn sits in a saucer, rather than a cup, that holds it fast by the close incurving rim. The kernel is white and very bitter. The range of the Red Oak is from Maine to Georgia, and west to Kansas and Minnesota.

Slender as pins are the twigs and small branches of the Pin Oak, *Quercus palustris*. The central shaft, unbroken to the top, the pendulous lower branches, and the gradually shortening upper limbs give the tree a regular pyramidal shape in its youth which is suggestive of the conifers, rather than the broad-leaved trees. It is a favorite tree for parks and avenues. But its wonderful grace and symmetry are lost as the tree approaches middle age, and it takes on a rugged and picturesque irregularity. The leaves resemble those of the scarlet oak, but are cleft by wider sinuses. The acorns are small and round, set in a shallow saucer. The tree grows from New England to Minnesota, and south as far as Maryland and Arkansas.

The Scrub Oak, *Quercus pumila*, is a dwarf among the oak trees. It grows in colonies among the rocks where soil is poor and scarce. Its leaves are somewhat like those of the post oak in outline. It grows in New England and

Leaf of Black Oak

Trunk of Red Oak

among the foothills of the Alleghenies. It is also called the Running Oak, from its rapid spreading.

Another shrubby oak which likes to grow on barren areas is the Black Jack, *Quercus Marilandica*. It has small, pear-shaped leaves, which are often shallowly three-lobed at the apex. It is found from New York to Kansas, and south to Florida.

The Shingle or Laurel Oak, *Quercus imbricaria*, grows to be a large tree in the central states. It is of a wayward, irregular habit, but is a handsome tree when clothed with its bright foliage. The leaves are narrowly oval, and entire in margin, resembling the leaves of the mountain laurel.

The Willow Oak, *Quercus Phellos*, is a handsome tree easily distinguished from others by its willow-like leaves. It has slender, drooping twigs, and grows best near water. It is found from New York to Florida, and in Texas. It is popular as a shade tree in southern cities.

One type of Red Oak leaf

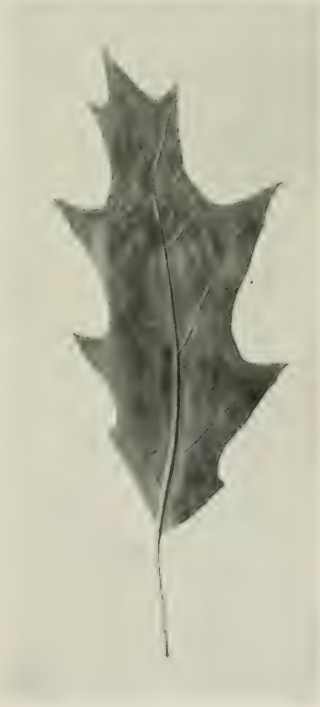
An Oak Apple cut across

The "oak apples," found upon the leaves of many species of oak, have always been a source of wonder to people. Some still think them seed balls like those that grow on the tops of potatoes. They are abnormal growths, each caused by a single insect that feeds and develops inside from an egg laid in the soft leaf tissues early in spring. A strange fact is that each one of many types of these oak apples is made by a distinct species of gall-insect. There is no variableness. Each one keeps to its own pattern.

These galls are more likely to abound on young trees. Perhaps it was this fact that justified the old herbalist, John Gerard, in describing "the gall tree" as "a kinde of oke." The following quotation is copied from his description:

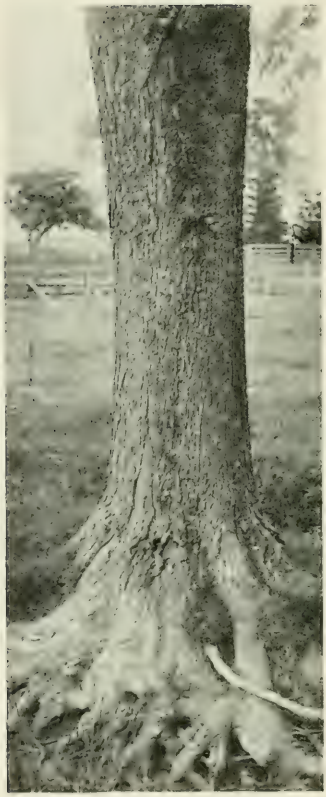
"The oke apples being broken in sunder about the time of their withering doe foreshew the sequell of the yeare, as the expert Kentish husbandmen have observed, by the living things found in them: as if they finde an ant, they foretell plenty of graine to ensue: if a white worm like a gentill or magot, then they prognosticate murren of beasts and cattell; if a spider, then (say they) we shall have a pestilence, or some such like sickenesse to follow amongst men: these things the learned also have observed, and noted that before they have an hole through them, they containe in them either a flie, a spider, or a worme; if a flie, then warre ensueth; if a creeping worme, then scarcitie of victuals; if a running spider, then followeth great sickenesse or mortalitie."

Acorn of Red Oak



Another type of Red Oak leaf

THE MAPLES



Trunk of Red Maple

Fourteen species of maple are native to America, nine of which occur east of the Rocky Mountains. To these have been added many Japanese and European kinds which seem quite at home here, and greatly enhance the beauty of parks, avenues, and private grounds. Japan is believed to be the ancestral home of the maple family, and in spite of emigration that has scattered its species so widely over the earth, two-thirds of the deciduous trees to-day in the Island Empire belong to the genus Acer.

In general, maples agree in having opposite leaves, which are palmately veined, and more or less cut into three or five lobes. Their flowers are small and borne in clusters which are close or elongated into racemes. The fruit of maples is the most distinctive character of the genus. It is a pair of samaras, or keys joined at their bases, and each one flaring toward its apex into a broad thin wing. Another characteristic of most trees in this genus is sugary sap of delicious flavor.

The Red or Scarlet Maple, *Acer rubrum*, loves the swamps. It grows, too, on hillsides if the soil be moist, and thrives when planted in parks and along village streets. If there is one maple that excels the others in beauty, it must be this one. In early spring its swelling buds glow

like garnets on the brown twigs. The opening flowers are red. The young leaves, which open with the flowers, are red. Red also are the wings of the dainty keys as they dangle on their long flexible stems among the full grown leaves in May. The keys ripen and fall, and through the summer we find a tinge of red only in the veins of the leaves. But early in September the tree suddenly remembers! Some morning we look across the marshy meadow, and see a Scarlet Maple like a flaming torch among the other trees. Or, far up the hillside another one, against the dark green of hemlocks, shows its color like a splash of blood. All the glory of the autumn is expressed in this gorgeous tree. In winter the lover of the woods, revisiting the scenes of his summer rambles, will see the Scarlet Maples standing, clean-limbed, gray-trunked and bare of foliage. He will know the trees by the knotty, full budded twigs which gleam like red-hot needles in the dusk of a winter twilight. The Red Maple never quite forgets its name.

Leafy spray of Red Maple

Leaf of Silver Maple

The Silver Maple, *Acer saccharinum*, is also known as the Soft and the White Maple. Its leaf is larger and more deeply cleft than that of the red maple, and has a silvery lining. The flowers are greenish, have no petals, and expand before the leaves. The fuzzy green fruits become smooth and veiny as they mature. Like the

Trunk of Sugar Maple

red maple, this species prefers low ground, but grows to noble proportions even where moisture is scarce. It has a much less compact head than the red maple. Its slender branches spread widely and are disposed to droop. A beautiful cut-leaved variety with weeping habit is called Wier's Maple.

The Sugar, Rock, or Hard Maple, *Acer saccharum*, is economically the most important of the maples of this country. It is the tree from whose sap maple sugar is made. It is the tree that paints our October landscapes with yellow and orange and red. As an avenue tree, it is unsurpassed. It is also the great timber maple. The valuable curly and bird's-eye woods loved by the cabinet-maker are found among Hard Maple logs as well as among those of the red maple. This curling is not a constant character, but an occasional wrinkled condition of the grain, induced by the persistence of dormant buds or by some other disturbing causes not well understood at present. The Hard Maple is a large, slow-growing tree, of compact habit. Its oval head is made of many ascending branches. Its leaves are firm and broad, shallowly cleft into five lobes, and variously toothed. The flowers open late, and hang on the season's shoots in yellow hairy clusters. The fruits are smooth and plump, and hang on the trees till midsummer.

The Black Maple, *Acer nigrum*, is a large, slow-growing tree, much like the preceding species, and by some botanists considered a variety of it. Its bark is rough and dark. Its foliage is of a somber cast. The leaves are variable in form, but in general have three broad lobes, each tapering to a single point. While the leaves of the preceding species are smooth and pale beneath, those of the Black Maple are green on

SUGAR MAPLE

Acer saccharum

Keys of Sugar Maple

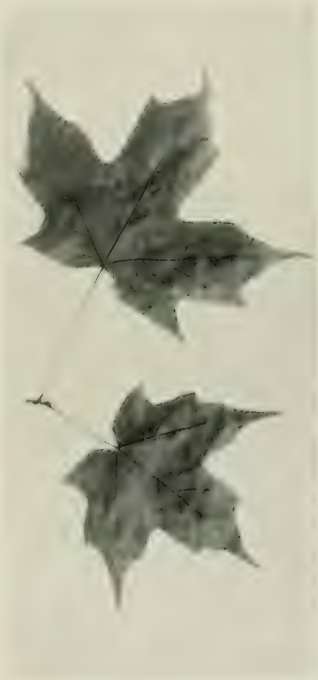
both sides and pubescent along the veins underneath. The sap of this tree is rich in sugar.

The Norway Maple, *Acer platanoides*, introduced from Europe, is one of our most popular shade trees. It has a low, round head, shingled over with large, elaborately lobed and toothed leaves. The flowers are borne on the shoots of the season and open before the leaves. They are yellowish, smooth, and have both calyx and corolla. The samaras are large, flat and widely divergent from the straight line in which they are united. This tree has milky juice, which is somewhat viscid.

The Sycamore Maple, *Acer Pseudo-platanus*, the great timber maple of Europe, is popular as an avenue tree in America. Its leaves are very large, five-lobed, with margins coarsely saw-toothed and crenate. The late-opening flowers are borne in long racemes, on which the little key fruits hang on the tree all winter.

In moist woods and along the edges of forest highways one often catches a glimpse of two little maples, the Mountain Maple and the Striped Maple, which are the Tom Thumbs of their family. They are lovers of the shade, and keep company with the hazel bushes and the trailing yew, while others of their kind are reaching up and contending for places on the upper surface of the forest crown.

The Mountain Maple, *Acer spicatum*, is scarcely more than a shrub, but it is always dainty and beautiful, with its smooth, ruddy stems and twigs, whether they bear only clusters of tiny brown keys or the erect racemes of yellow flowers and the clear green lusty foliage. Each leaf is large and three-lobed, with tapering points, toothed margins, and heart-shaped bases.



Leaves of Sugar Maple

Keys of Norway Maple

The Striped Maple, *Acer Pennsylvanicum*, sometimes grows to be quite a tree. It has the most beautiful bark, bright green and smooth, with pale lines streaking it in a delicate and characteristic fashion. Its leaves are large, ending with three triangular lobes on a level. They have finely saw-toothed margins. The flowers are yellowish and hang in drooping racemes. They are followed by smooth green keys with spreading wings. Moosewood, this tree is called, for moose like it.

The Box Elder, or Ash-leaved Maple, *Acer Negundo*, was formerly called *Negundo aceroides*. It differs from all other maples in having compound instead of simple leaves, and in bearing the staminate and pistillate flowers on separate trees. These differences were formerly considered important enough to justify placing the Box Elder in a genus by itself. However, these differences are only accentuations of tendencies we have already seen among the maples. The Box Elder is one of the fastest growing and most hardy trees in cultivation. It has had a prominent place among the shade trees planted in the prairie states. In older regions it generally gives place to slower growing trees. The chief objection to it is that it is always shedding something. The profusion of its silky fringes litter the ground under the staminate trees in spring, the leaves fall in and out of season, and the pistillate trees shed their burden of seeds from early winter till late spring.

Fruits of Box Elder

Leaf of a Japanese Maple

An ideal maple tree in Europe or America will be one of great size and fine symmetry. In Japan the people take their greatest pride in tiny maples grown in pots. These miniature trees have been bred and cultivated for centuries. Their leaves and fruits show wonderful variations in form, coloring and texture. At a certain season of the year when the maples are at their best it is the fashion for all the people to turn out and view them.

THE BASSWOODS, OR LINDENS

In the log school house of an earlier day the benches were simple, rude affairs hewn out of native lumber. Many an old man remembers how promptly he used to dispatch his chores and betake himself to school on the morning of the first day. Zeal for learning he had, no doubt, but greater at that critical moment was his zeal to preëmpt a seat for the term on a basswood bench. It was so much softer than those made of oak!

I venture he has not forgotten the cold all day trips his father used to make to the timber, where he cut the wood for next year's fuel! When the boy was big enough to help, he went along on Saturdays, armed with the old ax; and the chances are that his first lesson in the new craft was taken on the smooth round bole of a young basswood. From his father the lad learned to know trees by their shapes and their bark, but he remembered them best by their behavior under the ax. The basswoods were ever the most comely to him, for they never played him any tricks, as did the stubborn, knotty trunks of oaks and hickories. When he went back in June, the wooded hillside stood transformed. The basswoods were all green and alive above their well remembered trunks. Against their dark foliage hung

Trunk of Basswood

clusters of creamy blossoms, each on a dainty pale green blade. And out of them came a great wave of fragrance, honey-sweet, and the low music of contented bees.

In the autumn, when the hazel bushes opened their husks, and butternuts were falling, it was fine to finish digging potatoes in time to go nutting on a Saturday afternoon. The leaves of the basswoods were falling then, and on the bare twigs, ruby-budded in promise of next year's growth, hung downy gray seed balls on russet blades. To curve and tilt and cling as the wind tossed them about, one by one to loosen their hold and to whirl and drift away — this the boy read as the closing chapter in the year book of the basswood trees.

Leaves of Basswood

The genus Tilia, which includes all our basswoods, may be counted an alien in our cold climate, for it is the only member of the great linden family that has left the tropics. It is evidently well content, for it ranges widely in the northern hemisphere. There are about a dozen species, all told, three of which are native to the eastern half of the United States. All basswoods have soft, even-textured wood, and tough, fibrous inner bark. The leaves are simple, heart-shaped, more or less one-sided, and the perfect flowers are borne in clusters on a leaf-like blade.

The Basswood, or Linden, *Tilia Americana*, is the largest and most wide-spread of our native species. It is found from Georgia to New Brunswick, and west to the foothills of the Rocky Mountains. It is distinctly a lovely tree; all the lines of its spreading limbs and broad crown are curved and graceful, and its foliage is smooth and tropically luxuriant. The creamy flowers, followed by oval fruit, are attached to a slender bract that tapers at the base.

The Linden or Bee Tree, *Tilia heterophylla*, is next in size and breadth

of distribution. It is distinguishable by its large leaves which are green and shiny above, and lined with close white down. The fruits are globular, not oval, and are borne on a blade like that of the basswood. The tree is common in forests from Pennsylvania south and west. The dancing foliage, with its striking contrast of light and shade, is a picture always to remember, once it is seen.

The Linden, or Basswood, *Tilia pubescens*, last and least of our native species, is found scattered from Long Island to Texas. Its dainty leaves are downy or woolly underneath, as are also its twigs and fruit. The blade that bears the fruit pellets is short and rounded at each end. The tree prefers moist soil, and thrives best near the coast.

Flower cluster of the Basswood

The lindens of Europe, much planted in America, are, as a rule, carelessly classed together under the name *Tilia Europæa*. There are, however, several distinct species of them, and many varieties.

The basswoods are very easily grown from seeds. Each fruit contains one or two vigorous seeds. As they are eaten by no animal, and are well protected from drying, and as their leafy parachutes adapt them to distribution by the wind, it is not strange that lindens often win in a race with oaks, hickories, and maples. Sargent says that in the virgin forests of America the basswoods, scattered among other broad-leaved trees, often formed two-thirds of the entire growth.

Another easy mode of propagation is by cuttings. A lusty basswood twig grows in moist soil almost as readily as a twig of willow. One of the finest specimen trees I know grew from a walking stick cut in the woods and thoughtlessly stuck in the ground when the rambler reached home. Ornamental varieties are propagated by grafting cions on native seedling stocks.

Lindens are quick-growing trees. They endure with patience the severest pruning. These two facts have long commended them to gardeners, who cut them with impunity into figures, geometrical and grotesque, that are characteristic of the formal garden. The beauty of their natural forms has also been appreciated. Lindens are planted as specimen trees, for shade, and for luxuriant foliage effects in landscape gardening. The most famous avenue of them in Europe is probably "Unter den Linden" in Berlin, though in stature these trees come far short of the expectations of the average tourist. Avenues of lindens, called lime-

trees, are common features of the landscape in England. The old Greeks loved the tree for its beauty, and for its blossoms. What did not the hives of Hybla and Hymettus owe to the bloom of linden trees? The Romans loved it, and gave it an honored place in their literature. In the north, the same feeling was native. Linnæus, the Swedish botanist, had his name from a fine linden tree, when his peasant father rose to the dignity of a surname. Carl Linné (Charles of the Linden) it was at first; then Corolus Linnæus. when he became professor at Upsala, and "the father of botany."

Opening shoot of Basswood

John Gerard discourses very quaintly upon the linden tree in his "Grete Herball," or "Generall Historie of Plants," published in England in 1597. "The male tree is unknown to me," he says. We smile at the notion that there are male and female trees in this family; but we wonder at the accuracy of observation evinced by one who lived and wrote before the science of botany was born. Evidently Master Gerard had a good pair of eyes, and he told well what he saw.

OF THE LINE, OR LINDEN TREE

"The female line, or linden tree waxeth very great and thicke, spreading forth his branches wide and farre abroad, being a tree which yieldeth a most pleasant shadow, under and within whose boughes may be made brave summer houses and banqueting arbors, because the more that it is surcharged with weight of timber and such like, the better it doth flourish. The bark is brownish, very smooth and plaine on the outside, but that which is next to the timber is white, moist, and tough, serving very well for ropes, trases and halters. The timber is whitish, plaine, and without knots; yea, very soft and gentle in the cutting and handling. The leaves are smooth, greene, shining and large, somewhat snipt or toothed about the edges: the floures are little, whitish, of a good savour, and very many in number, growing clustered together from out of the middle of the leaf: out of which proceedeth a small whitish long narrow leafe: after the floures succeed cornered sharp pointed nuts, of the bignesse of hasell nuts. This tree seemeth to be a kinde of elme, and the people of Essex (whereas great plenty groweth by the way sides) do call it broad-leafed elme."

BASSWOOD

Tilia Americana

WILLOWS AND POPLARS

Somewhere in the family records of the plant kingdom the scientist may yet find traces of the common ancestor of poplars and willows. They are closely related. The family Salicaceæ includes but the two genera, Salix and Populus. They are trees or shrubs which are native chiefly to the north temperate and arctic regions. As a rule they thrive best when growing in marshes and along watercourses. They grow rapidly, producing soft, weak, pale-colored wood, of even texture, and of little value for lumber. They start early in spring, their twigs and branches taking on in March a lively color. The flowers are borne in furry catkins, the staminate and pistillate sorts on different trees. The shape of the scale that bears the single flower is the chief distinction between the two genera. The willow scale has an entire margin; the poplar scale has its margin adorned with notches or saw teeth. Both kinds are edged with silky hairs, and it is the overlapping of these hairs that makes the silken fur of the gray "pussies."

The fruits mature very early. The pods open and discharge tiny seeds which sail far and wide, each on a tuft of silken floss. The seed is small, and very soon loses its vitality by drying. To compensate for this weakness of their seeds, willows and poplars have brittle twigs that strike root when they drop on moist ground. The trees also have the power to send up shoots from their roots, and from the stumps after trees are cut down.

Pussy Willows

THE WILLOWS

The willows all belong in the genus Salix. There are one hundred and sixty recognized species, and many natural hybrids which have been produced by

Trunk of White Willow

the chance intercrossing of closely related species. The parentage of these hybrids is often problematic. Trees of the same species differ greatly when grown under changed conditions. For these reasons the relationships of the willows and their classification is a matter of great uncertainty at present. Seventy-nine American species are described, of which about one-half grow east of the Rocky Mountains. They vary from tall trees to creeping arctic shrubs, which dare the rigors of the far north along with the stunted birch. It is a strange circumstance that only six American willows ever attain large size. Even in these species the rank and file of individuals are shrubs or small trees, a height of sixty feet being exceptional.

The willows have their winter buds sheathed in a single leathery scale, which has a thin delicate lining. The leaves are thin and narrow as a rule, and short-petioled. The scales of the catkins have entire margins.

The Black Willow, *Salix nigra*, is usually a small, slender tree, though it sometimes attains the height of one hundred feet or more. It is found chiefly along streams and lake margins. Among our native willows it is the most common one to grow to the stature of a tree. Its range is from the Rocky Mountains eastward to the coast. A characteristic of this species is the almost black bark, which is rough and flaky. The leaves, which appear with the flowers, are very slender and tapering, pale beneath, and hairy on the veins. A pair of heart-shaped stipules grow at the base of the short leaf stalk, and persist until midsummer.

The White Willow, *Salix alba*, is a European species early introduced here, and now growing wild. It contrasts strikingly with the tall black

willow, for its trunk is short and thick, and its head is broad. The bark is ashen gray. The chief beauty of the tree is in its dancing leaves, which are silky, and pale beneath, and fairly illuminate the landscape. Bared of foliage, the tree shows irregularities, which make it very ugly. It is often pollarded, after which it throws out a brush of long straight suckers about the stub.

The Golden Osier, *Salix vitellina*, is commoner than the white willow in the eastern states, and is often mistaken for it. The branches and twigs are orange-yellow, hence the name.

The Crack Willow, *Salix fragilis*, is a tall, graceful tree, with rough gray trunk and fine symmetrical head. Its leaves are large, dark green above, and dull grayish white beneath. The foliage mass is bright and cheerful like that of the white willow. The reddish green twigs snap readily at their bases. More than any other willow does this species cast its twigs upon the ground and upon the water. Its tribe increases at a corresponding rate along the banks of the streams. The tree is of European origin, and has been exploited in this country as a hedge tree. It is propagated by driving into the ground green stakes which root and grow. It seems to make no difference in the growth if the stick is inverted. Seed of the Crack Willow is rarely seen, for staminate trees are very scarce.

The Weeping Willow, *Salix Babylonica*, a native of Asia, is a tall, stout-bodied tree, with long, slender, drooping branches. The narrow leaves seem fairly to drip from the twigs. It is commonly seen in cemeteries. This is the common weeping willow, but it is not perfectly hardy in the northernmost parts of the United States. The hardiest of all kinds is the Wisconsin weeping willow, a tree of uncertain origin and parentage, which is sometimes called *Salix Babylonica*, var. *dolorosa*. Weeping willows, which are round-headed trees, have a graceful sweep of branches, and

Leaves of White Willow

an expression that is cheerful. The Babylonian willow has a dejected look that is depressing to the spirits.

The Peach-leaved Willow, *Salix amygdaloides*, is known by its leaves, which resemble those of the peach and almond. The tree grows to medium height, and is found all over the country, skirting the banks of streams. Its bark is ridged, and is little disposed to shed in flakes or scales.

Besides the willows so far described, there are over seventy American species that never grow higher than ambitious shrubs. Nature must love these little willows, she has made so many of them. The Sandbar Willow, *Salix fluviatilis*, helps the larger species to hold the islands of sand in their places, and to prevent the river from changing its course. The landscape is made beautiful by the billowy green foliage that covers the stretches of sand, and the debris brought down by the river in time of flood. The Broad-leaved Willow, *Salix glaucophylla*, has been planted on the great dunes of shifting sand that pile up along the southern shore of Lake Michigan. Once it gains a foothold, this little tree grasps the sand in its fibrous roots and holds it where it is, the growth and its foundation sand drifts acting as a protection to the country behind them.

The Osier Willow, *Salix viminalis*, is the basis of a great industry. All sorts of wicker-ware are made of its supple twigs. Nearly one hundred varieties of this species are grown in Europe for use in basket weaving. This business is new in America, but it has been successfully established in central New York. It is likely to pass rapidly through the experimental stages and become a great industry here as it is abroad.

Had little willows none of the uses ascribed to them, we should still value them for their beauty. Few are lacking in grace when they grow alone; many are soft and beautiful in effect when they grow together. The bare twigs of willows show the first sign of the relenting of winter. A willow copse is full of color at any season. The Shining Willow earns its name by the gleam of its brown twigs long before its glossy leaves appear. The Purple Willow has its color on its young branches. March pussy willows are dressed in Quaker drab, but the staminate catkins of willows that blossom in May are not so demure. Turning them in the light, one sees under the sheen of silky hairs a play of colors as varied and as evanescent as those that glow in a Hungarian opal. It is in these delicate colors of willow, and other early spring blossoms, that the Japanese artists find their chief delight. Soon the colors fade, the golden pollen pushes out, and there is no such sight for us again until next spring.

In point of beauty, the "unimproved" sorts of willows have, I think,

the great advantage over cultivated kinds. Compare the Glaucous Willow, *Salix discolor*, the early "pussy willow" of the bogs, with its city cousin, the Kilmarnock Willow, that produces such an abundance of coarse staminate flowers.

The Shining Willow, *Salix lucida*, deserves a place of honor on home grounds. Its glossy foliage is its especial charm. The transplanting of it is an easy matter.

The Silky Willow, *Salix sericea*, has purplish twigs, and its young leaves are densely covered with silky hairs. When these hairs are shed, the pale linings of the full grown leaves make this little tree one of exceptional beauty throughout the summer

A narrow-leaved cultivated Willow

All willows surprise us by their adaptability. Often a species that loves the bog will thrive when planted high and dry on rocky knolls. There are some species that prefer the dry ground and thrive amid rocks and sand in arid districts. In arctic regions and on mountains farther south, are many species of willows that interest the botanist and the general explorer. They are stunted to pigmy size, often rising not more than six inches from the ground. But when the brief arctic summer comes they unfold their leafy shoots and hang out their catkins. In spite of adverse conditions, they never forget that they are willows, and hold loyally to all the rites and traditions of their family.

THE POPLARS

The poplars are plebeian trees, but they have a place to fill in the economy of nature and of man, and they fill it with credit. They are rude pioneers that go before and prepare the way for nobler trees. When fire sweeps a path through the forest, the poplar is likely to be the first to heal the breach. Under the shade of its lusty saplings the seeds of more valuable trees are able to grow. By the time these are big enough to take care of themselves the poplars have reached maturity. They graciously give way, and the old-time forest is gradually restored. We follow nature's hints by using poplars and willows as "nurse trees" in our lawns and yards. It is a good idea to plant poplars with young oaks or other slow-growing trees which require slight shade for some years. When the poplars have reached maturity or lost their beauty they may

be cut out to give the more permanent and beautiful trees the space they need. Poplars are also useful in screening unsightly objects.

About their prairie homes the early settlers always planted poplars first. They were sure to grow, and to grow fast. In such busy times, these were the cardinal virtues in trees. East and west we see remnants to-day of this early planting. Venerable cottonwoods stand alone at crossroads. Broken lines of shabby Lombardy poplars tell where there was once a fence row of them. A forlorn white poplar in the midst of a pasture may once have sheltered a pioneer home, furnishing the only break in a monotonous, treeless sea of grass. What tales—what history these derelict trees could tell!

Trunk of Silver-leaved Poplar

The chief vice of the poplars is but virtue carried to excess. Great tenacity of life enables them to spread rapidly by suckers from the roots. This may be well in a forest, but where the ambition to multiply and replenish the earth gets possession of a dooryard tree it becomes a nuisance. Cutting off the saplings and suckers only encourages them to fresh activity. To root them all out is the only way to check the trouble, and it is a long and laborious task. The poplars are like willows in many particulars. They are in general thirsty trees, growing best in moist soil. They are quick-growing and lusty, producing soft weak wood. Branches driven into the ground, or twigs that fall in favorable situations, strike root and grow. The flower and fruit are like the willow, but more vigorous and showy.

Despite the close relationship, the differences between willows and poplars are very marked. The twigs of poplars are angled and stout, giving the trees a rigid look when compared with the supple grace of

willows. The winter buds of poplars are encased in overlapping scales, and in many species sealed tight with a glutinous substance. The hairy scale that supports the individual flower of the catkin is notched, instead of entire, as in the willows. The leaves of poplars are broad and thick, and set on long petioles. The genus Populus has about twenty-five species, of which twelve are native to this continent, and nine grow east of the Rocky Mountains.

The White Poplar, *Populus alba*, also called Abele and Silver-leaved Poplar, is a large round-headed tree. Its leaves are dark glossy green above, and lined with a white cottony nap. This contrast of light and shade in the foliage is most unusual and attractive, especially in early spring. But soon after the leaves unfold, they collect soot and dust in their fuzzy linings, which they carry to the end of the season. Another great fault of the White Poplar as a dooryard tree is its disposition to sprout from the roots. The wind breaks the brittle branches, and these accidents threatening its life, the tree in self-defense sends up suckers which form a grove about the parent trunk, and defy all efforts to eradicate them. The White Poplar is a native of Europe. It has spread widely in America, first as an ornamental tree, and later spontaneously by escape from cultivation.

Silver-leaved Poplar twig

The Cottonwood, *Populus deltoidea*, our largest poplar, is a stately tree, with sturdy gray trunk, and broad symmetrical dome. The tree grows in moist soil from the Atlantic coast to the Rocky Mountains. Its leaves are triangular, broad at base, and tapering to a slender point. They are fixed upon long slender petioles. The foliage mass is bright green and glossy, and responsive to every breeze. The staminate tree is especially beautiful in spring, when decked with the rosy catkins. The

Trunk of Lombardy Poplar

flowers make little show on the pistillate trees. They are easily overlooked among the green leaves. When the fruits are partly developed they become conspicuous as long racemes of green balls. The custom among children of stringing these fruits into necklaces gave the tree its early botanical name, *Populus monilifera*, meaning "necklace-bearing poplar." In early summer the pods discharge the minute seeds, each one of which is wafted away on a delicate silken float.

The Swamp Cottonwood, *Populus heterophylla*, is a slender tree of medium size, which grows in boggy ground from Connecticut to Louisiana. Its leaves are ovate and blunt, lined in spring with white fuzz, which is seen also on young shoots. For this reason the tree is called the Downy Poplar.

The Black Poplar, *Populus nigra*, of Europe, is sparsely scattered in this country. It resembles the cottonwood, but has smaller leaves, which are more shallowly toothed. The foliage mass is dark and lusterless when compared with that of the cottonwood. Closely allied to it is the next species.

The Lombardy Poplar, *Populus dilatata*, is one of the most striking of tree forms. Its narrow, spire-like outline is familiar to all. The branches grow up closely appressed to the central stem. The young tree is a thrifty grower, but the top soon becomes choked with the multitude of branches. The great buttresses of the lower trunk grow coarse and warty. The tree retains its dead branches, and the beauty of its youth is departed. Insect enemies attack the wood and the foliage. The roots continually send up suckers. The extermination of these is well-nigh impossible. The Lombardy Poplar has been much planted as a roadside tree, but without good reason. It gives little or no shade, except

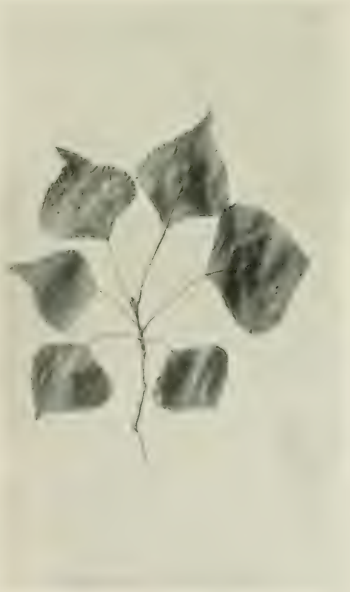
LOMBARDY POPLAR

Populus dilatata

when set too close for comfort or health of the trees. I fancy the uniformity, the formal, soldier-like bearing of a row of them was what caught the fancy of those who planted them. Nevertheless, the Lombardy Poplar has a place in landscape-gardening. Two or three of them in a close group among round-headed trees add a pleasing variety to the scene. They may be planted singly here and there, in order to repeat the strong vertical lines of spire, chimney, or tower. Or at the very end of a row of some other kind of tree, one of these may stand like an exclamation point, and serve to revive the interest in a country that would otherwise be flat and featureless. But as a roadside tree, or standing alone, the Lombardy Poplar is stiff and cheerless in aspect. As its name implies, it came originally from southern Europe. Some botanists consider it a variety of *Populus nigra*.

The Quaking Asp, or Aspen, *Populus tremuloides*, is a beautiful tree when young. Its bark is gray and smooth. An Aspen copse is one of the finest things in the spring landscape. It is worthy the brush of a Constable or a Corot. In March the bare limbs show green under their bark, one of the first prophecies of spring. Then the buds cast their brown scales and thrust out the fuzzy gray catkins as a guarantee of good faith. As the season advances, there are few shades of olive or rose, few textures of silk and velvet, that are not duplicated as the catkins lengthen and the downy leaves unfold.

The Russian peasant says of the Aspen of Europe, "There is a tree that trembles though the wind does not blow." We may say the same of ours. If you have never examined an Aspen leaf, you have a treat in store. You may be curious to know by what subtle mechanism the Aspen accomplished its feat of perpetual motion. The long, pliant leaf stems are flattened in a plane at right angles with the blade, and on the stillest summer day, against the motionless foliage of other trees, the Aspen leaves



Leaves of Lombardy Poplar

twinkle and dance and catch the sunlight like ripples on water. And the sound of them is music, soft and melodious.

The Large-toothed Aspen, *Populus grandidentata*, is distinguished from the species just described by its coarser habit, and by the large and irregularly rounding teeth of the leaf margins. This tree grows in low grounds and rich woods from Nova Scotia south to North Carolina, and west to Minnesota and Tennessee.

The Balsam Poplar, *Populus balsamifera*, is known in winter by its great terminal buds, that are varnished with a fragrant, glutinous substance. The tree has small oval leaves, which are pale or rusty underneath. The branches grow erect, with some suggestion of the Lombardy poplar habit, but the head never elongates enough to be confused with the latter species.

The Balm of Gilead, *Populus balsamifera*, var. *candicans*, a cultivated variety of the balsam poplar, is one of the finest shade trees in the genus. It has a round head and dark rich foliage. The broad heart-shaped leaves are paler beneath. The waxy buds of these Balsam Poplars are industriously visited by honey-bees in early spring. They collect the resinous wax and make a cement with which they seal up cracks in their hives. The name "Propolis" is given to this cement by bee-keepers.

We read in the botanies, "The wood of poplars is weak, light and of slight value for fuel or lumber." In the forests, poplars have been considered "weeds," to be fought, or tolerated only as temporary "nurse trees" for seedling conifers and hardwood trees. But the perfecting of the processes of making paper and miscellaneous articles, from a baby's rattle to a car wheel, out of wood pulp, has suddenly raised the poplar to a position of great economic importance. A forester has recently said: "If I could replace the maples in the state forest by poplars to-day I would do it gladly. It would be worth thousands of dollars to the state."

WALNUTS AND HICKORIES

The family Juglandaceæ has but two genera and about a dozen species in America, and yet no tree family has done more to give value and character to our virgin forests. Here are the nut trees. Here are woods of the highest value. Here are shade and ornamental trees second to none in size and beauty.

Hickories and Walnuts have many points in common. Their flowers are much alike. The pendant catkins of staminate flowers hang just back of the terminal clusters of pistillate ones. The leaves are always compound and borne in tufts toward the ends of the branches. The fruit shows an important structural difference between the two groups. A hickory nut is smooth-shelled, and drops when ripe out of the husk, which splits into four valves to discharge it. A walnut has no such natural splitting of the husk. It has one complete envelope which is moulded over the rough, deeply cut shell, and there it remains until it is torn off or decays. The Walnuts are rather rougher, sturdier trees than the hickories. Each kind has a distinctive character which is easily learned.

Trunk of Black Walnut

THE WALNUTS

The Black Walnut, *Juglans nigra*, was one of the giants in the primeval forests of eastern North America. Now it is rarely met with above

Leaf of Black Walnut

medium height. An occasional specimen which time and the lumberman have spared, may stand one hundred and fifty feet high in rich soil. There is something at once majestic and melancholy in the poise of such a tree, with its towering trunk, and dark, drooping crown. The leaves of the Black Walnut when crushed and the hull of the globular fruit have a rich aromatic odor. The smooth pitted outer rind turns yellow as it ripens. The hard shell beneath it is dark colored and deeply sculptured. The kernel is sweet, but contains much oil, which unfortunately soon becomes rancid. On this account, there is but a local and temporary market for the nuts.

East of the Alleghenies the Black Walnut is not a common tree. West, as far as Minnesota and Texas, it occurs more frequently. The wood is coarse-grained, purplish brown, and has a silvery luster when polished. It is very scarce and high-priced now, and is used chiefly in veneering. Old stumps are bought wherever they can be found and carefully taken up to be used for this purpose.

The Butternut or Oilnut, *Juglans cinerea*, is a smaller tree, with rougher bark than the black walnut. By a tendency to develop the under bud on the twig the branches acquire a horizontal rather than an upward trend, which gives the tree a broad dome-like crown, supported by a short, stout trunk. The color of the trunk is light brown; of the branches, grayish green. The twigs and leaves and husks of the nuts are clammy when growing, and covered with a soft pubescence. The oblong nuts have, when ripe, wrinkled husks under which the shell is cut into deep, thin, irregular ridges. The kernel is sweet and pleasant of flavor, but like the

Part of Black Walnut husk with nut inside

black walnut, it soon becomes rancid. The wood of Butternut is paler brown than black walnut, but it is in no points inferior as an ornamental wood. In house finishing Butternut is particularly beautiful, the "natural wood finish" bringing out the quiet tones of brown and the soft luster of the grain. Compared with it, black walnut woodwork in a house always looks somber and severe. The Butternut is a quick-growing tree, and is so liable to attacks by insect and fungous enemies that we find few trees sound that have attained to middle age. The long arms of the tree break easily in the wind. The twigs of all walnuts have chambered pith, which makes the entrance of fungi easy and the healing of wounds difficult. The Butternut grows from New Brunswick to Georgia, and west to the Dakotas and Arkansas.

Trunk of Butternut

The English or Persian Walnut, *Juglans regia*, now so profitably grown in southern California, spread long ago from Asia Minor to China, then west to Europe. It is a tender tree, and will not endure our northern winters. Were its fruit less valuable it would still be planted for its lumber, which much resembles the black walnut, and is not inferior to it. It is also cultivated for ornament in southern climes.

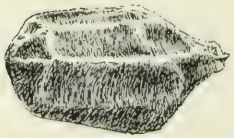
The Japanese Walnut, *Juglans Sieboldiana*, a small tree of the butternut type, has recently been introduced into this country, and promises to become a profitable nut tree in the regions where the English walnut is not hardy. It is a prolific bearer, and its fruit is said to be superior to that of our native species.

The walnuts tend to vary and to intercross and produce natural hybrids. New varieties have been produced by artificial crosses. While

Pistillate flowers of Butternut

horticulturists are propagating and exploiting these new and better kinds of walnuts, it behooves us all to keep planting the old kinds, especially in areas from which the trees have been taken. We may thus atone for the sins of our forefathers, who stripped the land of the first walnut crop and had not the foresight to provide for another.

Walnuts are not hard to grow. The nuts should be stratified over winter; that is, buried in layers of sand or soil. This keeps them moist, while the frost weakens or cracks the shells. In the spring they are ready for planting. Cracking the shell by hand just before planting is often done, but is likely to injure the embryo. Planting the nuts in the fall invites theft by squirrels. However, many a fine young grove have I seen from freshly gathered nuts planted where the trees now stand. The most important rule is, after all, *plant them*.



A Butternut

As street and dooryard trees, our two native walnuts have some drawbacks. The leaves appear late in the spring, and the yellowing foliage is shed early in the fall. They are commonly infested by caterpillars and other insect enemies. Until the spraying of shade trees becomes a common practice, let us set them, not in our front yards, but back a little, where the perspective is just right to emphasize their fine stature and luxuriant foliage, while obscuring unpleasant details.

Butternut leaf

What other fire was ever so hot, so brilliant, or so cheering, as one fed by seasoned hickory logs! What other lumber combines so well the qualities of hardness, toughness, and strength! What other nuts are so good to eat as hickory nuts!

It certainly looks like open favoritism for Nature to plant all but one of the hickories in eastern North America. A single species found in Mexico is the only one native to any other part of the world. But here they are, and we are proud and happy to have them. Among the six or more species there is not one to make excuses for. Tall, symmetrical, stately trees they are, whether clothed in summer verdure, or lifting bare arms up to a wintry sky. Hickories have no look of heaviness nor of weakness. There is, rather, that fine blending of strength and grace which is seen in the sinewy frame of the athlete.

Trunk of Shellbark Hickory

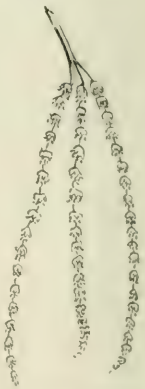
The genus Hicoria has no more valuable species than the common Shagbark Hickory, or Shellbark Hickory, *Hicoria ovata*. Its common names call attention to its most noticeable character. The tree begins very early in life to shed its bark in long, thin vertical strips. These often remain attached at the middle some time after they have sprung away at the ends and sides. The leaves of this tree have commonly but five leaflets, though sometimes there are seven. The branches end in stout twigs, which have prominent terminal winter buds with dark and pointed outer scales. In the late spring the unfolding of these great buds is a sight to remember. The outer scales drop off, but the inner ones, smooth and satiny, lengthen

Leaf of Shellbark Hickory

and curve back, forming a graceful gauntlet, out of which the young leaves rise like fingers of an opening hand. The fruit of the Shagbark is second only to the pecan in popularity. It always commands a good price. It is a thin-shelled nut, sweet and of excellent flavor. The range of this species centers in the Ohio valley, but the tree is found, north and south, from the Mississippi valley to the Atlantic coast.

The Big Shellbark, *Hicoria laciniosa*, is found growing from New York to Oklahoma. It is a tree of large size, with pale gray bark which is shed in thin plates, after the fashion of the common shellbark. "King Nut" the tree is also called by reason of its fruit, which is like the common shagbark in form and flavor, but is much larger. In winter this tree may be distinguished from all other hickories by its orange red twigs.

The Mockernut or Big Bud Hickory, *Hicoria alba*, has close gray bark which shows no tendency to peel in strips or to grow shaggy. The great terminal buds of this tree shed their outer scales early in winter, exposing the inner yellow silky ones. These lengthen in spring, displaying a red lining, which makes the tree as striking and beautiful an object as the shagbark at the same season. The Mockernut has the stockiest twigs and branches to be found among the hickories. The leaves are large, with seven to nine leaflets, which yield a pleasant aroma when crushed. "White-heart Hickory" is a name applied to this tree by reason of its white sapwood. This is a misnomer, for the heartwood is brown. That the fruit is a great disappointment the name "Mockernut" gives ample warning. First comes the big four-parted husk; then a bony shell of inordinate thickness, inclosing a kernel,



Staminate flower cluster of a Hickory

SHAGBARK HICKORY

Hicoria ovata

very sweet indeed, but so small that it does not pay for the trouble of getting it out. The tree is commonest in the Mississippi valley, though it is found sparingly to the Atlantic coast.

The Pignut, *Hicoria glabra*, has all the traits of a fine lawn and park tree, and by any other name might come into the popularity it deserves. But who, by taking thought, would wish a "Pignut" tree to be planted in the midst of his lawn? It seems incongruous to the average person. We must lay the blame on the early settlers, who named the tree when they saw their pigs fall upon the nuts with avidity when turned out to forage in the woods. The botanists might have re-named the tree the "Smooth Hickory"—*glabra* meaning smooth—for the twigs and leaves are usually free from pubescence. The bark is close and gray, and cut with shallow fissures. The branches are strong and slender, and end in delicate drooping twigs. The winter buds are small and brown. The nut is borne in a thin four-ridged husk that opens half-way to the base. The nutshell is very thick and hard. To human taste the kernel is insipid or bitter, but to the creatures of the woods it is altogether delectable. Few nuts are spared to grow except in years of unusual plenty. The Pignut has a very extensive range, and exhibits a marked tendency to vary. Occasionally a tree shows the bark-shedding peculiarity of the shagbark, and has smooth leaves of but five leaflets. Some botanists call this form *Hicoria glabra*, var. *microcarpa*. Others think it is a distinct species, and they call it *Hicoria microcarpa*. It seems like a hybrid between the Pignut and the shagbark.

The Bitternut, or Swamp Hickory, *Hicoria minima*, the most rapidly growing tree in the genus, reaches its finest proportions in

157 Trunk of Bitternut Hickory

Leaf of Bitternut Hickory

swampy land, though it grows into a goodly tree even on dry sandy soil. It is one of the handsomest of the hickories. Its bark is gray and rough on the trunk, but dark and smooth on the branches. A distinguishing mark of the tree is its tapering, flat yellow buds. The specific name, *minima*, meaning least or smallest, refers to the extreme slenderness of the leaflets, buds, and twigs of this species when compared with other hickories. No animal eats the thin-shelled bitter nut. It is inclosed in a thin husk, which is winged along its four unequal sutures. The Bitternut is widely distributed, but is most abundant in the Mississippi valley.

The Pecan, *Hicoria Pecan*, is the most important fruit tree among the hickories. Its nut is a staple article of commerce. The tree grows in the southwest, where it is highly esteemed as a shade and ornamental tree. It is graceful and slender of habit, and in rich soil often attains a height of one hundred and sixty feet. Its wood has little value. Horticulturists are gradually improving this species, reducing the reddish, astringent lining of the shell, increasing the size of the nut, and producing "paper-shell" varieties. The Pecan grows sparingly as far north as Iowa, though it scarcely can be called hardy there.

Opening of Shagbark Hickory bud

The wood of all our northern hickories is hard, heavy and extremely tough. It is very slow of growth. It is not used as an ornamental wood, but where strength and suppleness are called for, hickory is found to be exactly the thing. It has the strength of wrought iron, as tests have clearly shown. The handles of pitch forks and axes, and parts of many other agricultural implements, are best made of hickory timber.

Shagbark Hickory bud—
a later stage

The characteristics of the wood are suggested by the tough, close bark of hickory trees. The sway of its twigs, even, express their strength, as the soft maple's twigs in their motion confess their weakness. One needs but to try to break off a hickory twig to find that even the young fibers are like threads of steel.

The annual supply of shellbark hickory nuts has heretofore come to market from the wilds. The demand increases and the supply diminishes as forest areas are cut. Nurserymen and others interested in plant-breeding have been earnestly studying methods of improving and propagating these trees. Several hybrids have shown marked improvement over parent sorts. One variety of pignut with a sweet, edible nut has been obtained by careful selection, and promises to improve rapidly. Hickory trees are raised from seed planted where the tree is to grow, or in nursery rows from which they are transplanted to their permanent places. Transplanting is very hard to do successfully. The cutting off of side roots is a new and successful method of getting young plants. The roots are left in place, and the cut end is uncovered. On this exposed surface a leafy top grows. When it is well started the whole tree is transplanted.

Shagbark nut
in husk

At present the grafting of hickories is successfully done only by experts, but as the study of the subject proceeds, new and better success is coming. It is only a matter of time when nurserymen will offer in their catalogues hickory nut trees of many varieties, and orchards of these trees will be commonly planted and carefully tended. Even now, some nut orchards are as remunerative to their owners as are apple and peach orchards.

THE ASHES

An ash tree is well worth knowing, though it is not always responsive to friendly overtures. If you would really know a tree, you must learn to give it brief sympathetic glances as you pass it day by day. You need not often stop to parley, but without breaking step or losing a word in conversation you may take notice as you pass it, and register in your subconsciousness the progress the tree is making. "The last seeds will soon be shed," "These leaves have grown one-half their size since yesterday," or "Another day and we shall see those flowers shedding their pollen." When the changing phases of the tree's life have been observed from the bleakness of winter through the glory of summer, from spring around to spring again, our acquaintance comes to have in it elements of a personal friendship, and it is not willingly given up.

Trunk of White Ash

The winter aspect of an ash is rather forbidding. The tree then wears a reserved, indifferent air, in its snug garment of close-fitting bark. The top seems too heavy for the slender trunk. There is little liveliness of color, little promise of life to come, in the warty buds that sit face to face upon the stocky twigs. The spiny brown fruit stems that bristle on many trees speak only of things past.

March comes. Willows and poplars brighten, eagerly believing the

rumors of returning spring. Impetuous maples dare all things, and fling open their blossom clusters. The ash takes no notice. It seems to feel in its sluggish veins no stir of rising sap. Not until spring is well under way, and the woods are clothed in green, does this conservative join the majority, wake up, and put forth its leaves and flowers. On certain trees purple knobs swell out on the sides of twigs. They are the staminate flowers. In due season they mature and shake out a cloud of yellow dust. On other trees are sprays of delicate green pistillate flowers. They are destined to produce the seeds. All through the summer they twinkle and gleam among the dancing leaflets — these little green seeds, each flattened and pointed and feathered like a dart. Under the broad canopy of an ash in July we forget that we ever thought the tree had any shortcomings. As the summer wanes the green leaves of ash trees take on sober tones of lilac which deepen into purple. Or in gayer mood they may change to showy masses of pale or golden yellow. In no case is there in the foliage the least suggestion of red. This color seems to be tabooed by the whole ash tribe. The leaves fall, and the brown seed clusters survive them, often hanging late into the winter, giving up their seeds one by one.

Leaf of White Ash

Sometimes the stamens of ash are attacked by insects, which distort the flowers into gall-like growths, and cause them to remain on the trees, instead of falling when their duty is done. The tufted leaves conceal them during the summer, but in the autumn these abnormal stamen clusters are conspicuous on the bare twigs. They are sometimes gathered and planted on the assumption that they are the seeds of the tree.

Among other legends — and they are many in folk lore — is the story that ash trees have the power to ward off pestilence. This is true, but

it is by deep drainage, not by any supernatural charm, that the marvel is accomplished. The roots of ash are fibrous and thirsty. They go long distances in search of water which they take up and exhale through their leaves. Great swamps are drained by simply allowing these trees to spread over them.

Trunk of Black Ash

Ash trees belong to the genus Fraxinus, and are members of the Olive family. There are forty species known. Six of the twelve American species are found east of the Rocky Mountains.

The White Ash, *Fraxinus Americana*, is one of our large forest trees. When young it is slim and graceful, but it stiffens and broadens with added years. It grows in rich, moist woods from the Atlantic coast to Minnesota and Texas. Its leaves are downy when they unfold, becoming bright and shiny above and paler beneath. The ordinary number of leaflets is seven, each one on a short stalk. The winter buds are rusty yellow, set on greenish gray twigs that are marked with paler dots. The keys of the White Ash are borne in branching clusters. Each seed has a slender round body one-half as long as the pointed blade which is attached at one end of it.

The Black Ash, *Fraxinus nigra*, is a lover of the marshes, and is found from Newfoundland to Manitoba, and from Virginia to Arkansas. It is a handsome slender tree, which does not grow as large as the white ash. Its blue-black winter buds distinguish it from all its kin. Added to them, the somber green of its foliage and the dark hues of its bark and wood have strengthened the claims of this tree to bear the name "Black Ash." The leaflets, all but the terminal ones, are without stalks. The main leaf stalk is hairy beneath. The samara is oblong, not

BLACK ASH

Fraxinus nigra

Black Ash key

slender, its broad notched wing attached all around the body of the seed.

The Red Ash, *Fraxinus Pennsylvanica*, is a large timber tree that grows with the white ash throughout its wide range. It bears the slenderest, longest key of them all. The bark of this tree is reddish on the branches. The distinguishing mark of the Red Ash is the velvety coating of leaves and twigs, a sure guide to the observer in winter or summer.

Leaf of Black Ash

The Green Ash, *Fraxinus Pennsylvanica*, var. *lanceolata*, is so called from the bright green color of its foliage, which is smooth, in contrast with that of the red ash, to which it is closely related. As far west as Utah this tree flourishes, enduring drought as no other of the genus can do. Its luxuriant foliage makes it a favorite shade tree, particularly in the West.

The Blue Ash, *Fraxinus quadrangulata*, is a graceful tree of ample proportions that grows sparingly in the Mississippi valley. Its flowers, contrary to the rule among ashes, are perfect, having both stamens and pistils. The broad samaras are much like those of the black ash. The foliage is smooth and yellowish green. The bark contains a substance which gives a blue tinge to water. This peculiarity has given the tree its name. The distinguishing mark of the Blue Ash is its four-angled, often winged, twigs.

The wood of ash trees is tough, straight grained, and springy. It is especially desirable for the making of frames for farm implements and other machinery. It takes a good polish, and is much used in the manufacture of furniture. Black ash lumber parts readily into its annual layers, and is used for all kinds of splint basket work, and various other articles made by coopers. Ash trees do not form pure forests, but grow scattered among other trees.

THE BIRCHES, HORNBEAM, AND IRONWOOD

"Tatterdemalion birches!"

This exclamatory phrase by Mrs. Anna Botsford Comstock gives the clue to the character of these most interesting trees. Their threadbare, ragged apparel proclaims the members of this family, whether we meet them in the far north or below the Tropic of Cancer. Shockingly untidy are many of them, if we judge them by ordinary tree standards. But birches are far from ordinary. From the vagabond tree that skulks in the swamps to the stately conventional tree in the park they carry themselves with an air so graceful, so nonchalant that we find in them charms that are altogether irresistible. Whether their end be conversion into the ignoble shoe peg, or into furniture that shall pass for mahogany, the birches live their lives with cheerfulness. The beauty and individuality of each tree, young or old, is its own sufficient excuse for being.

Winter twig of birch

The genus Betula has thirty-five species, widely distributed over the northern hemisphere. As far north as seventy degrees the birches are still trees in Europe, and as shrubs they reach four degrees higher latitude. Of the nine American species of birch six occur east of the Rocky Mountains. They are generally quick-growing, short-lived trees, a few having considerable timber value. As a rule, the trunks of birches form a central shaft from which the branches rise, and end in supple, drooping twigs. The foliage is light and graceful, the simple leaves being thin and dainty. Horizontal lines called *lenticels* are conspicuous on the bark. They are organs of respiration.

The flowers of the birch are of two sorts, both borne on the same tree. The staminate catkins are terminal and lateral, and hang in plain view on the bare twigs all winter. The pistillate catkins are lateral, and are protected by bud scales. They are formed in autumn, but do not elongate until spring. Two or three ovaries are borne on each scale of the catkin, which becomes a small cone. The fruit is a flat heart-shaped samara, winged on the edge like the elm fruit.

The White Birch, *Betula populifolia*, has a twist in the stem of its little pointed leaf, which sets the tree top all of a tremble whenever the lightest breeze comes by. For this reason the name "Poplar-leaved Birch" is given it. Its chalky, thin outer bark is dingy white, and so "Gray Birch" is another of its names. In New England it is often called "Oldfield Birch," because it grows in fields abandoned by the farmer. The bark of this tree has a frayed-out look, but does not peel horizontally. The distinguishing marks are the dark furrowed base of the trunk from which the delicate, white outer layer is entirely gone, and the rough, dark, triangular patches, one under each branch, which grow with the tree's growth, even after the branch is dead and gone. In the northeastern states the White Birch is met with along streams and highways, always where the soil is unproductive. It is the gypsy of the birch family, stunted by generations of scanty living, but lithe and graceful, always flaunting its tawdry ribbons among the somber evergreens, and the staid and conventional broad-leaved trees.

A birch cone

"Like a fair lady in a far country" is the elegant European White Birch, *Betula alba*, varieties of which stand with high-bred poise, the central figure on many a lawn. In supple grace, in symmetry and in daintiness of twig and leaf it is unsurpassed among ornamental trees. In its native country it grows wild as far as the North Cape. The numerous varieties in cultivation may be grouped under two sub-species: *pubescens*, embracing varieties with downy leaves; and *pendula*, including varieties with drooping branches. If one wishes to plant a purple-leaved weeping birch, let him order *Betula alba pendula atropurpurea;* or write *laciniata* instead of *atropurpurea* if he prefers the dainty cut-leaved weeping birch. One cultivated variety of this species has the spiry habit and form of the Lombardy poplar.

Scale and winged seed of a birch

The Canoe or Paper Birch, *Betula papyrifera*, is a majestic forest tree when full grown. Its distinguishing characteristic is the habit of shedding its tough bark in curling horizontal plates, thus revealing layers of orange yellow under the white exterior. This birch bark made the canoes and wigwams of the northern Indians, and lends itself still to many uses both practical and æsthetic, notably letter-writing. A small strip of bark will furnish an incredible number of thin sheets. Summer tourists often girdle the trunks for souvenir letter paper. Unfortunately the process is

generally fatal to the tree. The birches in our lawns are often defaced and ruined by thoughtless persons. The white birch is very sensitive to girdling. It takes only a few minutes with a pen knife to destroy the beauty of a fine birch tree. Yet such a specimen may have been the growth of twenty or thirty years, and the joy of passers by all that time. The leaves of the Canoe Birch much resemble those of the American white birch, but the bark easily identifies each tree. The Canoe Birch ranges widely through the northern states and Canada.

Canoe Birch trunks

The Sweet Birch, *Betula lenta*, is called Black Birch and Cherry Birch, because its bark is dark colored, and looks much like that of cultivated cherry trees. The name "Sweet Birch" calls attention to the pleasant, aromatic flavor of its leaves, twigs and inner bark. The most distinctive characteristic of the bark of this birch is its habit of checking and splitting off in thick plates, but never curling back and shedding in horizontal strips. The tree rarely grows above medium height. It ranges from Nova Scotia to Florida, and west to Minnesota and Kansas. Its wood when polished is a close imitation of mahogany, and is much used in the manufacture of the cheaper grades of furniture.

The Yellow Birch, *Betula lutea*, is closely allied to the preceding species. However, its coarse deep cleft bark easily sets it apart from all its kin. It has a characteristic way of cracking at any angle and curling out its thick edges. The thin outer bark is yellowish or gray, and peels off in filmy layers, as often vertically as horizontally. The name "Gray Birch" is often applied to this tree because of the lusterless gray which shows under the shiny golden epidermis. The leaves and catkins are rather

AMERICAN WHITE BIRCH

Betula populifolia

coarser than those of the cherry birch, and the aromatic taste in the bark and twigs is much less pronounced. The tree grows to medium height and ranges from Newfoundland to Minnesota and Tennessee.

The Red or River Birch, *Betula nigra*, is a large tree which loves to stand knee-deep in water. It frequents the marshy shores of lakes and streams. In the soggy bayou country of the lower Mississippi it finds a favorable environment, and there attains its greatest size. The sturdy trunk tends to break soon into slender ascending arms, which are clothed to their extremities with loose shaggy fringes. From the membranous flakes that peel from the twigs to the coarse furrows of the lower trunk the bark of the tree is red — clear bright red above, dark brownish red below. The tree is beautiful, winter or summer. No other birch shows such rich coloring. When the foliage is gone, the tree is adorned rather than defaced by the flying tatters of bark which it wears all winter.

Fruit cluster of Hornbeam

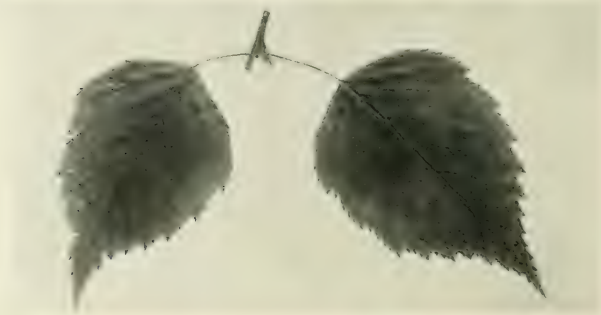
There are two little trees in the same family with the birches which grow here and there in the shadows of the larger forest trees. Each is the only child of its genus native to this country, although a European species of each has been introduced. The first one is the Hornbeam, *Carpinus Caroliniana*, called also the Blue or Water Beech. It rarely grows above twenty-five feet high, and adapts its shape to its environment. I have seen it flat-topped because it grew under an oak, and oval in outline when growing in an open field. In winter the delicate brown twigs taper out into the threadlike stems of the fruit clusters. The bark of the trunk and limbs is hard and very smooth. Swollen lines course irregularly up the trunk and out into the limbs. They look like veins on the arms of an athlete.

Through the summer the dark foliage is lightened by the feathery racemes of fruit. The nutlets are in pairs, and each one is provided with a pale green halberd-shaped wing. Long after the leaves have fallen, the fruit clusters still remain, each seed being anchored by a tough thread. When it does get free the little nut has a fine long sail through the air on its russet shield before it settles to earth. The wood of Hornbeam is very slow of growth, and is exceptionally tough and hard. An early writer says with feeling: "The Horne bound tree is a tough kind of Wood that requires so much paines in the riving as is almost incredible, being the best to make bolles and dishes, not being subject to

cracke and leake." It was used for making rake teeth and the handles of farm tools. In Europe the wood was early used for making the "horn beams" of ox yokes, and by age and use it came to look like horn itself. The names, Water, and Blue Beech, call attention to the blue gray bark and the leaves which look like those of the beech, and to the preference the tree shows for moist, deep soil.

The second of the little trees is the Hop Hornbeam or Ironwood, *Ostrya Virginiana*. Its fruit is borne in a hop-like cluster, each shiny seed enveloped in an inflated bag. These pale green fruits, hanging among the dark leaves, fairly illuminate the tree where it stands in the deep shadow, and give a feeling of refreshing coolness to one who comes upon it suddenly out of the glare of an August day.

The Hop Hornbeam tree often twists in growing, and the bark shows the spiral windings of the grain. Of all the rough-barked trees it has the finest-textured bark. The quality of its wood is indicated by its two popular names. It is also called Leverwood. He was a fortunate farmer in pioneer days who had a few Ironwoods in his wood lot. They were invaluable for making levers, sled stakes, rake teeth, and other like implements. It required great skill and infinite patience to work the wood, but once made, the tools, if kept dry, lasted indefinitely.



Leaves of Canoe Birch

THE ELMS

There are four native species of the genus Ulmus in the eastern half of the United States. They are valuable lumber and shade trees. All have rough, furrowed bark, but they vary in size and shape. They have one-sided leaves, which are ovate, straight-ribbed, saw-toothed, and borne in two-ranked fashion on the twigs. The flowers are small, and appear before the leaves in clusters from side buds. Each flower has a calyx with scalloped edges, a fringe of four to nine stamens hanging far out, and a central ovary. The seed is flat, and entirely surrounded by a thin papery wing. It ripens and falls in May before the leaves are fully open.

The Wahoo or Winged Elm, *Ulmus alata*, is a small tree which grows from Virginia southward, and west to Arkansas and Texas. Its leaves are the smallest among the elms. Its seeds are long and have flaring tips. The distinguishing marks of this tree are the corky, winged ridges on its twigs and branches.

The Cork Elm, *Ulmus racemosa*, is a large, coarse tree with rough, corky ridges on most of the branches. Its buds, twigs and fruits are hairy. The flowers are borne in racemes. The fruits are oval, and have incurving tips. This tree grows from Quebec west to Minnesota and Nebraska, and south as far as

Trunk of American Elm

Tennessee. It is also known as Cliff Elm, Rock Elm, and Swamp Elm. Its wood is heavy, and brownish red in color.

The Slippery Elm, *Ulmus fulva*, is also called Red Elm and Moose Elm, because its wood is red, and moose are fond of browsing its young shoots. The bark is rough, gray and fragrant. The leaves are large, harsh and doubly serrate. The winter buds have rusty hairs. The tree is best known by its sweet mucilaginous inner bark, which is much sought by the small boy in spring. The Slippery Elm has a wayward habit of growth. It has generally an unsymmetrical form when growing where it has plenty of room. There seems to be no co-ordinating influence at work to shape the head. Each branch starts out on its own account. The tree becomes more shapely when close tree neighbors, by crowding it, take a hand in its bringing up. The Slippery Elm is very generally distributed as far west as the Dakotas and Texas.

Opening shoot of Slippery Elm

Our common Elm, known also as American, White, and Water Elm, *Ulmus Americana*, excels all other species in height and beauty. The largest specimens reach one hundred and twenty feet, with a trunk diameter of eleven feet. The bark of this tree is gray and flaky. The twigs are round and smooth and brown. The branches are smooth, and the little twigs turn back instead of forward along the sides of the terminal shoots. The fat brown buds are set a little askew above the leaf scars which alternate along the sides of the twigs. The plumpest of these buds open in early spring, and the leafless twigs are decked with delicate reddish green blossoms, which speedily change to pale green pendants. These are the seeds. They ripen and fall while the leafy shoots are unfolding from the slenderer buds. The leaves are alternate, two-ranked, and have a fashion of arranging themselves so as to present almost a continuous leaf area to the sun. Leaves of varying sizes fill in every little corner to which the sunlight comes. This "leaf mosaic" is not confined to the elms. It may be seen in almost any broad-leaved tree or shrub. It is especially noticeable on the south edge of a dense wood.

There are several distinct types of our common Elm. (1) The "vase form." In this the branches spread gradually at first, but at a considerable height sweep out boldly, forming a broad and flattish head. The tips of the branches droop more or less. This is the commonest and most beautiful form, and is best realized by old trees which have had plenty of room. (2) The "plume form." In this the two or three

main limbs rise to a great height before branching, and then break into a feathery spray. (3) The "oak tree form." Here is a horizontal habit of branching. (4) The "weeping willow form." This has a short trunk, from which the branches curve rapidly outwards until they end in long, "dripping" branchlets. (5) The "feathered elm." This is marked by a fringe of short twigs which outline the trunk and limbs. This feathering is caused by the development of latent buds. It may occur in any of the previous types, but is most noticeable in the plumy elms.

The American Elm has a wide range. It is hardy and cheerful among new surroundings. It reflects the indomitable spirit of the pioneer whom it accompanied in his going from the eastern states into the untried treeless territories of the west. With him, the tree seized the land and made it yield a living. It has grown up with the country. People go back "down east," and marvel at the size of the elms there compared with those in the west. Give them a century more to grow, and there will be patriarchal elms in the Missouri valley as there are now in the valleys of the Connecticut and the Merrimac.

Twig of American Elm shedding ripe seeds

The English Elm, *Ulmus campestris*, is a large and handsome tree, which usually forms a pyramidal or oblong head. It is often planted in parks with the American elm, and the two trees present marked contrasts. The English tree looks stocky; the American, airily graceful. One stands heavily "upon its heels"; the other on tiptoe. One has a compact crown; the other a loose, open one. In October the English Elms on Boston Common are still bright and green, while their American cousins are in "the sere and yellow leaf."

The Scotch or Wych Elm, *Ulmus montana*, is planted freely in our parks and private grounds. It is a medium-sized tree of rather more strict habit of growth than the American elm. Before the leaves open the tree often looks bright green from a distance. This appearance is due to the winged seeds, which are exceptionally large, and are crowded upon

the twigs in great rosettes. This tree has many horticultural varieties. One of them is the Camperdown Elm, a weeping form, which arches its limbs downward on all sides, forming when full grown a natural arbor. It is named in honor of the Earl of Camperdown who admired the variety, and planted it extensively on his English estates.

American Elm leaves

Centuries of cultivation have developed a great number of horticultural varieties of each of the old world species of elms. The American elm has already a few named varieties. The native species have shown tendencies to vary, and will doubtless yield their full quota of varieties, beautiful and grotesque, as they come more under the observation and care of nurserymen.

The Hackberry, or Sugarberry, *Celtis occidentalis*, which is closely allied to the elms, is a tree of medium or small size. The absence of terminal buds induces a forking habit which makes the branches gnarled and crooked. The pith of young branches is white and chambered, a character that at once distinguishes the tree from the elms, which it resembles in leaf and bud. The Hackberry flowers are borne singly in the axils of the leaves. The fruit is a solitary one-seeded berry, very sweet, and dark purple in color. It dries and hangs on the tree all winter, to the great satisfaction of birds. The hackberry loves the river banks and moist, deep woods. It ranges from Maine to Minnesota and southward.

Another species, *Celtis Mississippiensis*, a small tree with entire and very tapering thin leaves and small fruit, is found from Illinois south. The wood of this species is paler and not so coarse-grained as is that of the common hackberry.

AMERICAN ELM

Ulmus Americana

I wish every one could visit New England. It is a necessary part of the education of an American. To the historical student each rood of land is holy ground. I wish you all could see the little villages in that goodly country, each with its wide street shaded by majestic, overarching elms and buttonwoods. To the people who see them year after year these trees may become commonplace. But to the prairie-born, they are simply overwhelming when first seen, and the wonder of them deepens as time goes on.

Especially impressive to me was the little village whose main street forms the frontispiece of this volume. It is hardly what you would call a populous village. There is just this one long avenue, with a few little feints at cross streets; no railroad, no factory, no noise, no bustle—just the quiet industries of a village whose commerce is with the thrifty farmer folk round about. It is not a village you could duplicate in the west, for the houses are century old, solidly built, and mostly innocent of paint. There are lilacs, purple and white, leaning up against the houses, and quaint, old-fashioned gardens shut in behind low picket fences.

The glory of the old place is its double row of superb American elms, which arch above the long street, intermingling their tops, and making of it a shadowy aisle with vaulted arches, like some vast cathedral. Long ago the villagers dug little trees in the neighboring woods and lined the road on both sides with them. Then they let them alone! Violets and ferns came with them from the woods, and spread undisturbed in their new environment. To-day they may still be seen among the gnarled roots of the patriarchal trees, springing out here and there as they have been doing for a hundred years. Like the trees, the houses that front upon this street have a distinguished air. They, too, are old, but they wear their years with gracious dignity. Among the New England villagers one finds a pride that is not vanity, and a self-respect that vaunteth not itself. Could the most heedless person, going in and out from day to day under those venerable trees, miss the influence of those mighty arms spread above as if in perpetual benediction?

The elms of New England are passing. Many have been patriarchs through three generations of men. For them perhaps it is time to be old! Drought, diseases, and insect ravages, singly and together, have attacked the trees in late years. Let us hope that New England people will plant more freely, and will succeed in controlling the enemies of the elm, that their venerable trees may be spared until they are replaced by worthy successors.

THE BEECH

Trunk of a Beech tree

"I can always tell when I am coming to a piece of beech woods just by the smell of the trees," said the man who loves to explore new regions on his bicycle.

"How do they smell?" I asked.

"Oh, as the beech nuts taste, I guess, when you get the first ones in October."

The beech commends itself to us through all of our five senses. To the sight first, for it is a noble tree, with ample round dome, and broad, horizontal spread when it stands apart from other trees; lofty and slender when crowded in forests. A lusty young beech is the most genteel-looking, the best groomed of all the trees in the winter woods. There is a quiet elegance of color and texture in the smooth, close-knit gray bark that covers the trunk. No less elegant are the polished dark branches, and the slender twigs, and the brown satiny "bird's-claw" buds. There is an exquisiteness in the weave and the fit of its garments throughout that is a model for trees and people. I suspect the beech tree of being fastidious as to its roots as well.

When the buds swell in April, and the tender green tips of the leaves appear, set off by the rich brown of the lengthening bud scales, a new and beautiful phase of the tree's life is revealed. The little leaves

are plaited like palm leaves, the parallel veins being crowded close to one another on the lower side. A comb of silky hairs is borne on each fold above, and on each rib below. These combs overlap each other, giving the unfolding leaves a silvery look, and furnishing them protection from cold and heat until the blades have spread and become acclimated. After a few hours the danger point is passed, the leaf walls thicken, the protective hairs begin to shrivel away, and the full grown leaves assume their duties as foliage.

With the opening leaves the beech hangs out on flexible stems its head-like clusters of stamens. They rise from the bases of the new shoots. In the axils of the leaves the pistillate flowers appear erect in twos on the ends of short stems. Each flower is in a scaly cup.

Through the long summer there is no tree more beautifully clad than the beech. The leaves are thin and soft as silk, and throughout the season exceptionally free from blemishes made by insects or by fungi. In the fall the four-valved prickly bur opens early to release the two triangular nuts that lie inside. But the beech gives up its foliage with greater reluctance. The leaves turn to a clear yellow, and cling to the twigs long after all others but the oak leaves have fallen. Young beech trees in sheltered situations generally retain their leaves until the following spring.

Beech leaves — "thin and soft as silk"

Staminate flower cluster

The beech nut is small, thin-shelled, and very sweet. It has a high nutritive value. European beech nuts have been used from the dawn of history as human food; the English named them "buckmast," because deer eat them. Exceptionally delicate is the flavor of pork when the swine are fattened by turning them out to forage in beech woods. The ancients loved the beech and extolled it in song and story. Ill luck, they believed, would

Fruit-bearing twig of Beech

overtake the man who used its wood as fuel. The tree was to the old Greeks the symbol of prosperity.

Beech wood is hard and heavy, straight-grained, and close of texture. In contact with the soil it is not durable. Furniture, coopers' wares, and household utensils are made of it. Wooden bowls made of beech never leak. Pure forests of beech are common in Europe and in America. It is the important hard wood of Germany. The seeds are vigorous, the saplings strong and shade-enduring. It is easy to see that a colony soon springs up about a single tree, and that a few trees scattered through the woods often, in a few years, make conquest of the surrounding territory. A mixed forest may gradually become a tract of beech woods.

The genus Fagus belongs to the Cupuliferæ, the cup-bearers, and is related to the chestnut and the oak. The cup it bears is the prickly husk in which the two nuts are borne.

The common Beech, *Fagus Americana*, is our one native species. It ranges all over the eastern half of the continent, its western limit being Wisconsin and Texas.

The European Beech, *Fagus sylvatica*, is much planted in parks in this country. Its head is more oval than our native tree and its bark is darker gray. Its leaf is glossy and dark green above, paler beneath, and is smaller than the leaf of the American species. There are in cultivation many ornamental varieties which have been derived from the European Beech. The Purple or Copper Beech has glossy dark red leaves. A handsome form of it is the Weeping Purple Beech. Another variety has its leaves deeply cleft; another is a contorted and dwarfed form, grotesque rather than beautiful.

The roots of the beech have no power to feed the tree. This peculiarity is not exclusively confined to this tree. The oaks, the locusts, and many of the conifers share it. The gathering of food from the soil is done by the filaments of a colorless fungus whose delicate meshes form a web over each root tip of the tree. This fungus gathers food from the porous soil about the roots. The fungus has no green coloring matter, and it never sees the sun; hence it is unable to make starch, and would die if dependent upon its own exertions for food. A treaty of reciprocity exists between the tree and the fungus. The latter gathers plant food from the soil, and transmits it to the roots of the tree. It mounts as crude sap to the leaves, when sunlight, acting upon the green leaves, converts raw food-stuffs into starchy

AMERICAN BEECH

Fagus Americana

compounds. A part of this product returning to the roots is shared with the fungus. Thus mutually helpful, the tree and the fungus thrive, as if they were intimate parts of a single organism. The scientist calls this *Symbiosis*, or a *symbiotic relation* between roots and fungi.

In transplanting beech trees, one must handle them very carefully. If great quantities of the fungus are torn away, or if the roots are allowed to become dry, the tree is doomed to die of starvation.

LOCUSTS AND OTHER POD-BEARERS

Among our common trees are a few whose fruit proclaims their family connection with the peas and beans. They are all pod-bearers. Most of these trees carry the resemblance farther, and bear flowers of the sweet pea type.

Trunk of Locust

The common Locust, called also Acacia and Yellow Locust, *Robinia Pseudacacia*, is one of the familiar pod-bearing trees. It is a beautiful tree in its youth, with smooth bark and loose round head; but many of its charms are lost as it grows up. Nine months of the year the old Locust tree is a bedraggled-looking object. The bare tree is covered almost to its tips with coarse ragged bark of a dead gray color. In its form, there is little of symmetry, or grace, or strength. The splitting pods hang on the twigs late into the winter, chattering in the winds, and calling attention to the untidy appearance of the tree. The supreme moment in the Locust tree's life comes in May, when it stands clothed in verdure, against whose feathery masses gleam the white blossom clusters, heavy with perfume and alive with bees.

The leaves of this tree are light and graceful, and are composed of many oval leaflets. The foliage which appears in late spring is pale green at first with a silvery down upon it; but it soon becomes

dark green and smooth. Thus through the summer the tree shows constantly varying shades of green. All too early in autumn the leaves turn yellow and are gradually shed. In the axils of the leaves are borne in spring the thick drooping racemes of pea-like flowers. These are succeeded by the thin tapering pods.

At the base of the leaf is usually set a guard of two stout points. These are prickles, and not thorns, for no matter how large and wicked they look, they are but skin deep, and always come off with the bark. The twigs are stiff, with ridges running lengthwise, and an angle at each side, caused by the prominent shelf-like bracket which supports the leaf. The buds develop under the leaf-stalks, and so deep-set are they that until spring only their brown silky tips protrude from the middle of the three-lobed leaf scar.

Locust pods

The Locust grows quickly. When left to itself it often sends up suckers from root-stocks and takes full possession of neglected lands. It ranges wild from New York to Arkansas, and in spite of its bad habits has been widely planted as an ornamental tree. It has more than its share of insect enemies. The wood, though valuable, is generally rendered useless by the locust-borer, which riddles even the young shoots. No practical method of combating this pest has yet been discovered.

Pod of Kentucky Coffee Tree

The Clammy Locust, *Robinia viscosa*, is a little rough-barked tree which grows on southern mountain slopes. It has pink flowers, like the pea in form, and all the newest growth,—the twigs, buds, leaf-stalks, and flower stems,—are clammy to the touch.

The Bristly Locust, *Robinia hispida*, is a shrub much cultivated for its showy pink blossoms. Its twigs and leaf-stalks are covered with fine bristles.

The Redbud, or Judas Tree, *Cercis Canadensis*, is near of kin to the locusts. It covers its bare twigs thickly with rosy pea-like blossoms in April. The tapering pods are daintier than those of the common locust, which they somewhat resemble. The leaves are heart-shaped and simple,—an exception

to the rule that generally prevails among the locusts. The name "Judas Tree" keeps alive an old tradition that Judas Iscariot hanged himself upon one of these trees.

The Kentucky Coffee Tree, *Gymnocladus dioicus*, is the coarsest and the burliest of all our pod-bearing trees. It has thick clumsy twigs, and its branches are stout and stiff. The twice-compound leaves are unusually large. The flowers are borne in racemes, the staminate and pistillate ones usually being on different trees. They are small, greenish yellow and salver-form. In winter there are no signs of buds on the tree, and the heavy brown pods fairly weigh the branches down. The Kentucky pioneers used the seeds as a substitute for coffee. The tree is found growing wild in rich bottom lands from New York to Texas. It is by no means common within this range.

Leaf of Locust

The Yellow-wood, *Cladrastis lutea*, is a small tree with smooth brown bark and delicate branches. It bears long pendulous clusters of white pea-like flowers followed by thin small-seeded pods. The leaves have seven to eleven broad leaflets. The tree grows wild only in Kentucky, Tennessee, and North Carolina. It is extensively planted in parks and home grounds, where it is called Virgilia, the generic name given it by Michaux. Occasionally it attains a height of fifty feet in cultivation.

The Honey Locust, *Gleditsia triacanthos*, is the handsomest of our pod-bearing trees. It is known also as the Three-thorned Acacia. In the summer time its foliage is a feathery mass, of wonderful lightness and grace. The leaves are once- and twice-compound, both sorts on the same tree. So fine are the divisions and so flexible are their

leaf-stalks that the light sifts easily through, and for this reason, apparently, a Honey Locust tree is often leafy to its center. All summer the long slender pods add their velvety greenness to the various shades seen among the leaves.

The flowers are small, greenish, and inconspicuous, like those of the Kentucky coffee tree. The tree gets its name from the honey-sweet pulp that fills the pods, and is sometimes eaten when soft and green.

In winter, the Honey Locust reveals its distinctive character. Its form is typically erect, strong, symmetrical, with its angled branches spreading far in horizontal planes. The trunk is rough, but the branches are comparatively smooth. As in other locusts, the winter buds are hidden, but the rich, dark color of the bark gives the tree a look of life and vigor. The three-pronged thorns, which often beset the trunk and follow out to the utmost twigs, are modified branches that come out of buds set some distance above the nodes from which the leaves and flowers arise. They are the tree's strong defense against enemies that would climb its trunk, or browse its twigs. These branching thorns give the Honey Locust an asperity of demeanor which is unusual among trees. The rigidity and coldness of its winter aspect are emphasized by the rattling of the long, dry pods which hang late on the leafless twigs. In winter they let go their hold and go careening away over the snow and ice, their S-curve tempting every vagrant breeze to give them a lift. Lodging at last, the pods decay, liberating the hard shiny seeds.

The tree soon gains a wide natural distribution once it is introduced into a new region. As an ornamental tree it has most of the good points of other pod-bearers, and one of their faults: like the common locust, it is late in getting its foliage and early in putting it off. The range of the Honey Locust is from Ontario to Michigan, and south to Georgia and Texas. In cultivation the tree is found farther east.

PINES AND OTHER CONIFERS

The conifers are an ancient and honorable race. They form one of the proud old "first families" of trees. Along the shores of the Silurian sea they stood up, man-fashion, with the giant horse tails and the tree ferns, before most species of modern plants existed, and while the others were groveling at their feet. In the coal measures are found the mummied remains of these ancestral trees. The cycads in the Everglades of Florida are some of their surviving representatives. Smitten with years, they cannot long survive; and the pines, too, are in their decline. Other trees, more tenacious of life, with seeds more quick and sure to germinate, are strongly competing for room. Man has ruthlessly slaughtered them for timber. Forests of conifers do not spring up in the track of the lumberman. Human avarice has but hastened a decline inevitable in a state of nature. The conifers are grown old — the day is not far distant when they will exist only as man fosters them by cultivation.

Trunk of southern White Cedar

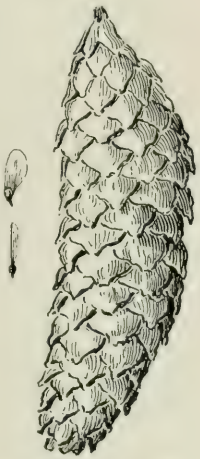
The pines and their relatives are trees, with resinous wood, clothed with stiff needle-like or scale-like evergreen leaves, and having inconspicuous flowers of two sorts borne in catkins. The pistillate catkin matures into a woody cone, each scale

of which bears a pair of winged seeds. To each of the above characters there are exceptions. For example, the larch is a conifer but not an evergreen, because it sheds its leaves at the approach of winter. On the other hand, in warmer regions, many trees which are not conifers retain their leaves the year around. Again, the yew and juniper are conifers which yield berries instead of cones, but the development of the berries shows their essential similarity to cones. Moreover, some trees, as the birch, have cone-shaped fruits, but they are not conifers.

The one character which is constant in the whole group, setting it apart from the rest of the plant kingdom, is expressed in the name *Gymnosperm*, which means "*naked seed*." There is no ovary in the flower. Two naked ovules are borne on each scale of the fertile cone. They are fertilized by the pollen falling directly upon them. All plants higher in the scale of life have the ovules inclosed in ovaries.

The Gymnosperms include the Pines, Spruces, Firs, Cedars, Junipers, Hemlocks, Larches, Cypresses, Yews, and the Gingko, or Maidenhair Tree.

The Pines. The genus Pinus is known by its long, needle-like, angled leaves. They are in bundles, two to five leaves in each, according to the species. There is a sheath of papery scales at the base of each bundle. The cones of pines are conspicuous, and usually require two years to ripen their seeds. There are about a dozen species of pines east of the Rocky Mountains.



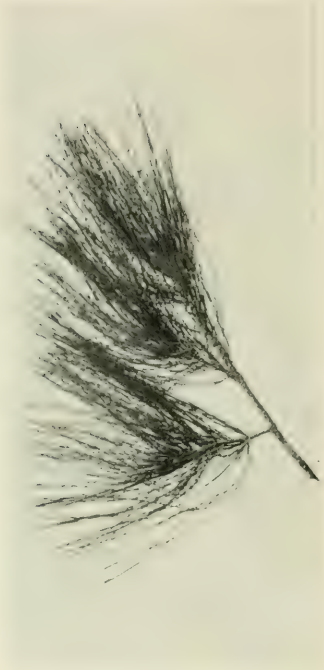
Cone and winged seeds of Norway Spruce

The White Pine, *Pinus Strobus*, is one of the most important of American timber trees. It formed a prominent part of the great forests that stretched from Newfoundland west along the Great Lakes. The species grows south along the mountains as far as Georgia. The tree sends up one straight shaft, sometimes to the height of one hundred and seventy-five feet, with whorls of branches coming out at intervals, forming horizontal platforms of foliage. Each whorl marks a year of the tree's life, for the terminal bud extends the stem, and at the same time, several of the buds that cluster around it grow into horizontal branches.

There is no evergreen more beautiful than the White Pine. Its foliage is dark and soft and plume-like, its bark smooth, its form graceful and symmetrical, or rugged and picturesque. We may always know the White Pine from all others by the number of leaves which

form its clusters. There are five leaves in each sheath. The long pendent cones have thin scales which are unadorned by any prominence at the tip.

The Long-leaved or Georgia Pine, *Pinus palustris*, is the most important of the hard pines. Extensive forests of it skirt our southeastern coasts from Virginia to Texas. This species yields not only valuable timber but also tar, turpentine, rosin, and all other by-products derived from resin. The Georgia Pine has begun also to be extensively used for Christmas greens. Its supple, glossy leaves, often sixteen inches long, are tufted closely upon the twigs. A branch with all of its long needles spread is as effective in decoration as a young palm.



Leafy shoot of White Pine

The Pitch Pine, *Pinus rigida*, is as picturesque a figure when old as the pine family can show. It is an eastern species, which is commonly seen on sandy or rocky soil. It covers a large part of the "Pine Barrens" of New Jersey and Long Island. It has the habit, unusual among conifers, of throwing up suckers from the stump when the tree is cut down. The struggle of a Pitch Pine's life is strikingly expressed by its rugged, undersized trunk, by the appealing reach of its tortuous limbs, and by the scant sickly-looking foliage, and the scraggy dead cones. Every vestige of symmetry is usually lost early in the life of the tree. The leaves are in threes, stout, yellowish-green, and tufted on the ends of the twigs. The squat cones, each scale of which is armed with a pugnacious-looking point, hang a long time on the tree, and add to its picturesqueness. The wood of this tree is rich in resin, which gives it the names Candle-wood Pine and Torch Pine. A fat "lightwood" knot is just the thing for a coon hunt.

The Spruces. The genus Picea includes tall, slender, conical trees,

SOUTHERN WHITE CEDAR

Cupressus thyoides

whose leaves are short and four-angled, each one being jointed to a projecting base. The leaves are ranged on all sides of the twig. The cones of the spruces are thin-scaled, long and pendent, maturing in a single season.

The Black Spruce, *Picea Mariana*, or *nigra*, is a medium-sized tree, which grows in cold swamps and on uplands in the northern tier of states and in British America. Its twigs are stout and hairy, its stubby leaves sombre of hue. The dry oval cones hang on the tree several years.

The Red Spruce, *Picea rubens*, or *rubra*, has practically the same range as the preceding species. It grows best in rich woods, but is found also

Trunk of White Pine

Leafy shoot of a Spruce

in swamps and on mountain slopes. Its leaves are slender and bright green, its hairy twigs slender, and its cones, which are much smaller than those of the black spruce, fall at the end of the season.

The White Spruce, *Picea Canadensis*, a northern species, has smooth twigs, pale green leaves, and very thin-scaled cones. When crushed the leaves and twigs give forth an unpleasant odor, which has earned for the tree the name "Skunk Spruce."

Fruiting Hemlock spray

The Norway Spruce, *Picea excelsa*, of Europe, is one of the commonest evergreens in cultivation. It is a beautiful tree, its branches even in old age laden with leaves and pendent cones sweep out in graceful drooping curves, in gradually diminishing lengths from the base to the tip of the central shaft.

The Hemlocks. The hemlock of history is a poisonous herb of the carrot family which grows wild in Europe and America. This was the hemlock which Socrates was compelled to drink. What we mean by "Hemlock" in America is what people call "Hemlock Spruce," or *Tsuga Canadensis*. In its early life this tree is one of our most beautiful evergreens. Though it loses its symmetry with added years, the oldest tree will yet show in its branches that graceful droop and feathery lightness which were the charms of its youth. The leaves of the Hemlock are flat, pale beneath, and attached by short petioles. They are really set all around the twig, but they part in the middle so as to appear two-ranked. The little pendent cones have papery scales. The Hemlock grows in Canada and the northern tier of states, and follows the Appalachian mountains to their southern limit. Its

Trunk and leafy shoot of Tamarack

wood is used in making the frames of buildings, and its bark yields tannin. A smaller species, *Tsuga Caroliniana*, grows in the Allegheny Mountains from Virginia to South Carolina.

The Firs. The genus Abies includes the firs. The Balsam Fir, *Abies balsamea*, is a slender, handsome tree of medium height. Its chief charm is its symmetry of form. The lower branches may droop, those midway up the stem spread horizontally, and those near the top ascend; or all may droop, or all ascend. In any case, there is a central stem with branches forming a conical head. The leaves of the Balsam Fir are arranged spirally around the twig, but are so bent as to appear two-ranked,

except on fertile shoots, where the leaves have their normal position, as in the spruce. The leaf is blunt at the tip, and pale beneath, having a white stripe on either side of the prominently-keeled midrib. The cones stand erect, the scales falling from the axis when the seeds mature. The bark of this tree is smooth and gray, abounding in little reservoirs filled with resin. The pricking and draining of these "blisters" is a considerable industry with the people living in the northern woods where these trees abound. The clear liquid is the Canada Balsam of commerce. Nothing is finer than a pillow filled with the needles of the Balsam Fir, as they retain their invigorating aroma for years. Fraser's Balsam Fir, *Abies Fraseri*, a slightly different species with notched leaves and smaller cones, grows on the mountains of Tennessee and North Carolina.

Twig of White Cedar of the South which looks much like Arbor-Vitæ

The Larches. The Tamarack, or American Larch, *Larix Americana*, is a slender tree with light branches which soon become scraggy. It spreads in cold swamps in the northern states and Canada. Its leaves are soft and needle-shaped, crowded in tufts or bundles on stubby branchlets, except on the terminal shoots, where they are evenly distributed. This tree sheds its leaves in the fall. The cones are small and erect when mature. The timber of the Tamarack is resinous, and very durable under water. The European Larches are more symmetrical and beautiful than ours. They are cultivated in America both for their timber and as ornamental trees.

The Bald Cypress, *Taxodium distichum*, is the only member of its genus. It is a large forest tree which grows in swamps from Delaware to Texas. It has a central shaft and spreading branches. Its delicate twigs bear the linear two-ranked leaves which are deciduous. The cones are small, globose, and hard-scaled. The roots have a way of humping out of the swampy ground, thus forming the angled "cypress knees" which act as braces, helping the tree to maintain its position in the unstable soil.

They are believed by some authorities to assist in the feeding and breathing processes of the tree.

The White Cedar of the South, *Cupressus thyoides*, is a fine tree of medium size which grows in swamps and along the sea shore from Massachusetts to Mississippi. The leaves are small, evergreen, awl-shaped, and borne four-ranked on flattened twigs. The wood has wonderful lightness and durability under water. It is made into posts, shingles, and buckets.

Trunk of Balsam Fir

The Arbor-Vitæ, *Thuja occidentalis*, also known as White Cedar, is a slenderly conical tree of medium or small size. It has awl-shaped four-ranked leaves, borne on flat twigs much like those of the southern white cedar. The winged seeds are borne in small papery cones made of very few thin scales. The Arbor-Vitæ forms dense forests in cold wet soil from Nova Scotia west to Minnesota and south along the Alleghenies as far as North Carolina. It is much planted as an ornamental tree, being a favorite for hedges in this country and in Europe. It lends itself to formal gardening, as it endures trimming into any shape.

The Junipers. The genus Juniperus differs from related genera chiefly in having the fleshy scales of the cone unite as they ripen to form a juicy berry.

The common Juniper, *Juniperus communis*, is a shrub or small tree with leaves in whorls of three. The leaves are sharp-pointed, boat-shaped, and have white linings in the grooved upper surfaces. The berry, which is large and dark blue, is used to give flavor to gin.

The Red Cedar, or Savin, *Juniperus Virginiana*, is usually a small tree, narrow and pyramidal in form. Its leaves are close and scale-like,

or spreading and needle-like. Young trees have more leaves of the latter class. The berry of this tree is small with a pale blue bloom upon it. The heart wood is red and very aromatic. It is largely used in the manufacture of lead pencils. The tree grows sparsely in sterile soil, wet or dry, from Nova Scotia to Florida, and west to Kansas.

Leafy shoot of the Balsam Fir

The American or Trailing Yew, *Taxus minor*, also known as the Ground Hemlock, is a sprawling shrub. Its leaves are narrow and two-ranked like the hemlock, but larger and dark green on both sides. Instead of a cone, the Yew bears a fleshy red cup in whose cavity lie the few seeds. This tree grows from Newfoundland to Minnesota and Iowa, and down the Alleghenies as far as Virginia. The Yew of Europe, famous in song and story, grows to be a great tree. It is often kept dwarf in formal hedges.

A strange and anomalous member of the gymnosperms is the Gingko, or Maidenhair Tree, of China and Japan, which is planted in American parks and gardens as an ornamental tree. Its leaves are broad with one deep narrow cleft somewhere in the margin. The venation is like no other tree leaf, but strongly resembles that seen in the leaf of the maidenhair fern. The leaves are borne in fascicles like those of the larch. They are not evergreen. The wood is destitute of resin. The fruit of the Gingko is a drupe much like the plum in appearance. Its flesh is inedible, but in Japan the nut within is considered a great delicacy, being served as an appetizer at banquets, like salted almonds. The Gingko tree was introduced into this country by Alexander Hamilton in 1784. It grows slowly and attains a large size. It is considered by botanists to be a remnant of a line of plants which had ancestors in common with the ferns and the conifers.

Gingko leaf

THE HORSE CHESTNUT

What boy does not know the Horse Chestnut tree and club it in the fall, "keeping an eye peeled" meanwhile for the irate owner? What do boys want Horse Chestnuts for, anyhow? They are not good to eat,—but they are excellent to carry in a fellow's pocket until they get brown and shiny. Their only use is to plague "grown ups," for every boy likes to tie a Horse Chestnut at each end of a string about three feet long, catch hold of the string by the middle, make the Horse Chestnuts go up and down at a bewildering rate, and finally shoot them upwards to catch on telegraph wires, where they make a hopeless snarl of dangling strings to bother tidy folks.

Horse Chestnuts in June

"But everybody knows all this," you will say. Nevertheless, I have not known it always, for my girlhood was spent on the prairies where I never saw a Horse Chestnut tree at all. So when I came to live where Horse Chestnuts grow, I did not realize the real meaning of the tree to children. I wrote a sober, scientific account of all its parts, without a spark of life in it—but I threw it away. I know now that there is something better than the botany of the Horse Chestnut tree, and that is the poetry of it. Read this letter from a lady who has been an invalid ever since she was eleven years old; one who yearns for the outdoor life of the country, but who spends all her days in a big noisy city, where even robins are rare neighbors, and the vision of a fleeting bluebird is a memory to be cherished through the long, dreary, winter months. I cannot tell you how sweet this is and why it brings the tears: But the meaning of it is, that there is poetry and beauty all around us in every common thing, and we, who have had health and eyes, have not seen it. Let us wake up and look about us and get

the most out of life every day that we live! Happiest are they who can still look out upon Nature with the eyes of childhood!

Here is the letter:

"My horse chestnut trees were five in number. Two were close to my windows and made a screen for my narrow balcony where I read and worked and rested when unable to do anything. These two were tall and symmetrical until mercilessly pruned. Even then they hastened to conceal their wounds. The outer row of three trees was lower, and from my bed I looked into a green chapel and saw nothing of the street. The houses across the street seemed far away and undisturbing.

"In February come the bright clear days when my reason tells me that it is not spring yet, that there are weeks more of winter; but something else tells me that a change has come, and that the rest of the winter really does not matter. Then do the buds of my horse chestnuts begin to glimmer and glisten. They seem to gather and hold the light. My windows faced the west, and all the long afternoons I knew that the buds were at least dreaming and moving in their sleep just a little. Often for weeks they made no progress, and I wondered if I had not been mistaken after all. Then, when the first warm days come, the buds swell with wonderful rapidity, and the protecting brown scales part and show the downy linings. The baby leaves are so beautifully protected!

Horse Chestnut trunk

"When the scales drop and the young leaves first begin to appear they are very light in color, a soft silvery effect, and they look like irregular fluffy balls. About this time, Clara and I always used to choose a particular bud, and tell each other when we expected to see the first tent. (The young leaves make the most perfect and exquisite tents just after they change from the upright position, and before they spread out like a hand with fingers extended.) To go back to the chosen buds. At that stage they develop so rapidly that they require much watching to be sure which really does become a tent first — so many are

HORSE CHESTNUT

Æsculus Hippocastanum

changing constantly. Sometimes the opening buds become tents in a few hours, if there is wind with bright sunshine, and then the dear old trees are enchanted, one watches them with awe and wonder and delight. I always feel that the dryads are a living presence at that time. They only stay a day or two or less, because the tents expand and hasten to become full grown leaves. It is a constant surprise to me how quickly they do become large and strong and dark and rich in color.

"I am always sorry for the new leaves in the first storm; they seem so dejected, and limp, and cold, and disappointed that the world is not all sunshine and soft winds.

"The flower buds are a delight from the first suggestion of future beauty until they shower pink and white petals on the ground and in my balcony. The horse chestnut blossom is so delicate and fragile and queenly. Not the least of its charm is that it is out of reach usually, and the loveliness must be half imagined, although no flower bears close examination better. The blending of pink and white and green is perfect.

"I have often wondered why birds seem to avoid the horse chestnut trees. Certainly the nests would be well concealed, and the large leaves would make excellent protection from the rain.

"The little burs are also of absorbing interest, green and tender and held up high out of harm's way with their young prickers preparing for a time of necessity. Then the adorable nuts in their opening husks, or burs, with the wonderful satin lining and the partition in the middle and two polished nuts, polished as only Nature can do it; not too shiny as if they had been varnished, but glowing with a subdued beauty of their own. When the autumn winds come, the nuts fall with a loud thud, and often I have moved my chair out of the range of the falling nuts. They strike the tin-covered floor of my balcony with such force that I could not feel quite at ease. Small boys love the horse chestnuts, and are not as careful of the trees as I could wish, and at first I feared that they — the small boys — might eat the nuts and come to grief. So I talked to one, a fearless climber who seemed

Horse Chestnut leaves

unwilling to leave a single nut, and he set my anxious mind at rest so far as his own safety was concerned. I did not feel so comfortable about the trees. One of our neighbors gathers the nuts from his own trees, using a step-ladder and pole so that the branches will not be broken by the feet of climbing boys. I fancy the boys hate him cordially, for they will not take any of the nuts which he offers from his great heap of shining, brown treasures.

"On windy nights late in the fall the yellowish leaves flutter and scurry across my porch and heap themselves in the corners, as if they were sure of a welcome, and I love to hear them and feel them. Did you ever notice the beautiful way in which the leaves are fastened to the branches and to their own stems? The bark, also, is wonderfully interesting and beautiful — lighter and darker as the light strikes it, and charming in effect with the changing weather."

* * * * *

I think this is a good place to stop. I had it in mind to tell of the buckeyes — those interesting American trees allied to the Horse Chestnut — but what do such things matter, if one does not care for trees? If you are a tree lover you can find out, easily enough. The first thing is to open the heart. The next thing is to open the eyes. This book would help all it can. It is an invitation to the outdoor world. Come, let us go out and see!

INDEX